DOCUMENT RESUME

ED 027 395 VT 007 627

By-Harkness, James P., And Others
A Manpower Study of Technical Personnel in Hospital Clinical Laboratories. Final Report.
Manpower Administration (DOL), Washington, D.C.
Pub Date Oct 68
Contract-MDTA26-64
Note-103p.
EDRS Price MF-$0.50 HC-$5.25
Descriptors-Automation, Clinical Diagnosis, *Evaluation, Evaluation Criteria, *Hospitals, Individual Characteristics, *Laboratories, Laboratory Techniques, Medical Evaluation, Medical Laboratory Assistants, Medical Technologists, *Occupational Surveys, Pathology, Performance Criteria, *Personnel Evaluation, Quality Control, Questionnaires
Identifiers-North Carolina

As one of the efforts related to closing the gap between the growing demands for clinical laboratory workers and the supply of well-trained workers, the volume and quality of laboratory procedures and the general characteristics of workers in North Carolina hospitals were studied. Approaches to the study included tests on "unknowns" by laboratory workers, interviews and questionnaires. Some findings were: (1) Hospital laboratories perform approximately the same ratio of tests per bed and have approximately the same ratio of workers per bed regardless of other factors, (2) As hospital size increases, so does the quality of work, (3) The areas of laboratory work most easily automated make up seven-eighths of the total output, (4) Workers trained in schools certified by the American Society of Clinical Pathologists, those trained in commercial schools, and those with on-the-job training only were almost equally represented, and (5) About half of all workers had had 5 years or more of experience but most earned less than $5,000 annually. Recommendations include: (1) more effective supervision by pathologists, (2) evaluation of laboratories by educationally oriented organizations, (3) regional laboratories to make automation feasible, and (4) patient admitting practices appropriate to the capabilities of hospital laboratories. (JK)

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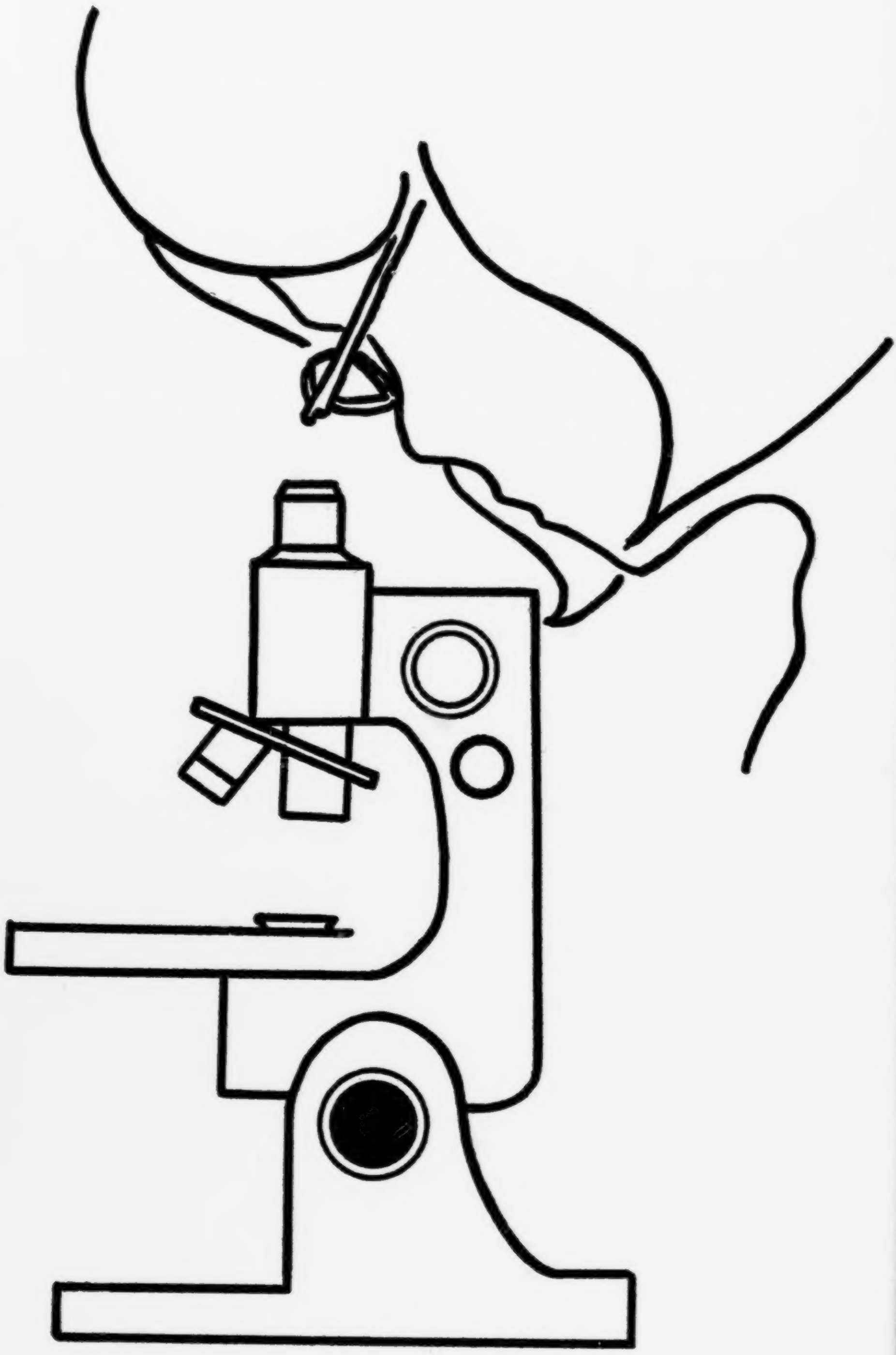
A MANPOWER STUDY OF TECHNICAL PERSONNEL IN HOSPITAL CLINICAL LABORATORIES



FINAL REPORT
Contract # MDTA 26-64
U. S. Department of Labor
1968

VT007627

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A MANPOWER STUDY OF TECHNICAL PERSONNEL IN HOSPITAL CLINICAL LABORATORIES

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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This project was prepared under Contract No. MDTA 26-64 for the Manpower Administration, U. S. Department of Labor, under the authority of the Manpower Development and Training Act. Researchers undertaking such projects under Government sponsorship are encouraged to express their own judgment.

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October 1968

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FOREWORD

This study is one of the many attempts underway at the federal, state and local levels to close the gap between the growing demands for clinical laboratory workers and the continual and guaranteed supply of well-trained clinical laboratory workers.

Focusing upon a sample of hospital clinical laboratories and their respective personnel, the study reports on the volume and quality of laboratory procedures and the general characteristics of workers examined in small, medium and large North Carolina hospitals. Like most occupational studies of specialized groups, the inquiry and subsequent analysis of the findings raised many new questions and disclosed new avenues of possible exploration. Nevertheless, every possible attempt has been made in the report to spell out concrete recommendations for policy planners, educators and workers suggested by the results of the investigation.

Participating Staff

Special consultants of the project have included George P. Vennart, M.D., formerly Associate Professor of Pathology in the School of Medicine at the University of North Carolina. He, as well as Ruth I. Heinemann, MT(ASCP), provided technical consultation to the study. James E. Grizzle, Ph.D., Department of Biostatistics, School of Public Health, University of North Carolina, reviewed sampling procedures and parts of the questionnaire design.

Three additional consultants in laboratory techniques and procedures provided their service to the study. Mrs. Helen P. Sullivan, MT(ASCP), assisted in the design of the technical questionnaires. Miss Frances Smith, MT(ASCP), assisted in the data collection. Mrs. Marcia B. Pendergraph, M.S., MT(ASCP), assisted in technical processing of the clinical data. Throughout the project, a full-time secretarial position has been filled and several part-time workers were hired for data processing.

The Advisory Committee

At the outset of the study, an Advisory Committee was appointed to help establish the course of the investigation and review the results. Two meetings of the Committee were most helpful for the project members in setting the general design of the study. Also, selected committee members reviewed the results of the final report with appropriate suggestions.

Acknowledgments

We should like to thank the clinical department heads in the School of Medicine at the University of North Carolina for their cooperation and assistance in many phases of the study. We especially wish to thank Hipolito V. Nino, Ph.D., for his interest and counsel in many clinical aspects of the study.

Also, we thank General Diagnostics, Morris Plains, N. J., Hyland Laboratories, Los Angeles, California and Ortho Diagnostics, Raritan, N. J., for their contribution of clinical materials for the study. Of course, no company nor product of any company was identified in the clinical aspects of the study. Hospital Care Association, Inc., Durham, N. C., allowed us to use some of their specialized data processing equipment for which we are thankful.

Finally, we thank those technologists who participated in the study, their laboratory supervisors, the pathologists, the hospital administrators and all others who contributed their time, assistance and technical knowledge. Without this voluntary effort, the project would not have been possible.

INTRODUCTION

The Problem and Method of Approach

The escalation of health services in this country has been accompanied by a more complex and scientifically ordered approach to the delivery of health care. Understandably, the clinical laboratories of the nation's hospitals, which are essential to modern diagnostic and therapeutic medicine, have been directly involved in this change. Recent statements by the U. S. Public Health Service indicate that "Many laboratories show annual workload increases of about 10 percent, thus doubling the work volume in approximately nine years." There is little reason to expect that this rate of growth will decline. In fact, with increased involvement of federal and state agencies in the delivery of health services through programs such as Medicare, there is almost an assurance that demands for laboratory services will rapidly increase.

It is generally recognized that there is an insufficient supply of skilled manpower in most parts of the country today to provide quality clinical laboratory services demanded. While it is not the purpose of this report to trace the long series of events which had led to the present situation, a few highlights in the development of laboratory technology are necessary to explain why technical personnel working in clinical laboratories have a variety of titles, training experiences, pay scales, working conditions and supervisory arrangements.

World War I is given as the probably beginning date for medical technology.[1] In 1928, shortly after its own founding, the American Society of Clinical Pathologists established the Registry of Medical Technologists. In the usual manner of medical registries, eligibility is based upon a completion of the required amount of training and a passing score on a national examination. Presently, three years of college training, a year of internship in an affiliated hospital clinical laboratory and a passing score on the national examination qualifies the candidate as MT(ASCP). The Board of Schools of the American Society of Clinical Pathologists has, since 1948, set standards and inspected training schools for those running programs leading to certification.

At the same time, however, many commerical schools of laboratory technology have opened and operated throughout the country without formal medical approval. Many of these schools have bound together to form their own societies and designations.

Currently, there are three major, self-established registries for laboratory technical personnel not under general medical auspices. These registries include the American Medical Technologist (AMT); the International Registry of Independent Medical Technologist (IMT); and the International Society of Clinical Laboratory Technologists (RMT). Understandably, training and certification requirements for these registries vary greatly, but usually the only formal requirement for commercial school enrollment is a high school diploma.

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[1] Trumbull, Merlin, M.D., "Medical Technology Changes in a Changing World", Hospital Topics, 1964.

Regardless of the training and ability of the technical personnel in the clinical laboratory of the hospital, the final medical responsibility of all laboratory results rests in the hands of a physician. Ideally, of course, this physician is a pathologist. The Joint Commission on Accreditation recognizes that the short supply of clinical pathologists cannot possibly meet the high demand, but recommends that at least the services of part-time pathologists should be available to all hospitals operating a clinical laboratory. Today, many hospitals must rely upon the part-time services of a pathologist (which can be a visit once a week or less) and it is not uncommon to find smaller hospitals operating clinical laboratories without the services of a pathologist.

The elements that set the stage for this survey study are the current shortage of personnel, with every indication that the demand for workers will outstrip the supply; the variety of qualifications and training for workers; and the increasing role of laboratory tests for the delivery of medical care. This investigation has, as its main purpose, the survey of the kinds of workers in small, medium and large hospitals located in all parts of the State of North Carolina.

The report reviews the volume and quality of laboratory work carried on in these hospitals after which categories of laboratory quality are established for each hospital size. Following this, worker characteristics are descirbed in each hospital size setting. The report ends with recommendations for future action.

The Sample

During the early months of the project in July 1964, an explanation letter announcing the study was sent to hospital administrators of the 160 short-term hospitals in North Carolina. Accompanying the letter was a self-addressed post card survey form. Results from 156 of the hospitals indicated that there were 1,056 hospital personnel performing laboratory tests in the hospital clinical laboratories. Table I indicates the distribution of this group by hospital size categories.

Using the results from this survey and other relevant factors, it was decided that approximately 200 technologists would be selected for study - proportionately representing the hospital bed size categories as depicted in Table I.

After eliminating the smaller hospitals that had no clinical laboratories from the universe of State hospitals, a random sample of hospitals (134 hospitals, stratified by bed size) was selected. Each technical worker in the laboratory became part of the sample population. Table I depicts the State, estimated sample and final sample. The results of the study are based upon the final sample figures.

Variations between the estimated sample of workers and the final sample were experienced in the field as laboratory supervisors, especially in the smaller hospital, noted recent decline in available personnel. One hospital declined to continue its participation in the study at a time when it was judged too late in the study to select another hospital.

Table I

Hospital Bed Size	Hospitals						Laboratory Workers Performing Tests					
	State		Estimated Sample		Final Sample		State		Estimated Sample		Final Sample	
99 and under	70	52%	15	50%	14	49%	271	26%	56	26%	38	19%
100-299	53	40%	12	40%	12	41%	367	35%	84	39%	89	45%
300 and over	11	8%	3	10%	3	10%	418	39%	75	35%	72	36%
	134	100%	30	100%	29	100%	1056	100%	215	100%	199	100%

The sample represents about 19% of the laboratory workers performing laboratory tests in the State, almost 22% of the hospitals in the State operating clinical laboratories and, of the 100 counties of the State, 29 counties from all parts of the State are represented.[2]

The Unknowns

Clinical laboratories rely upon various methods to insure that results of their procedures and determinations are accurate. For example, in the clinical chemistry laboratories, known standards are frequently and regularly used to insure that reagents, techniques and instruments are accurate. Within the last few years, reliable and reasonably stable control serum has become available and is used in the absence of, or along with, known standards in most laboratories to insure that determinations are accurate.

Another method of determining the accuracy of laboratory performance is the use of "unknowns". It is common practice, for example, for state health departments to send blood serum unknowns to hospital serological laboratories for testing. Of course, the results of tests made upon the blood serum are known to the state health departments and unknown to the hospitals which chose to participate in such health department programs. Hospital laboratory personnel report the results of their tests to the health department and, in this way, health departments have a measure of the quality and accuracy of work performed to certify the laboratory for these particular procedures.

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[2] County identification of the hospitals would have destroyed the anonymity of the study, since many smaller hospitals are the only health facility in the county.

In much the same way, members of this investigating team prepared, sent and evaluated the results of unknowns for the hospital laboratories selected for this study. Unknowns were used in the areas of: bacteriology, blood bank, chemistry, hematology, parasitology and serology. Figure I illustrates the various categories and the packaging method of the unknowns.

In all, 148 sets of unknowns were sent and returns were received from 114 laboratory personnel, 77% of the total. In only 3 of the 29 participating hospital laboratories were no responses received for the request to perform the unknowns.

Of the 199 laboratory workers in the study, 148 technologists received unknowns.[3] Returns were received from 114 of the 148, a 77% return. The high response to the unknowns by the MT(ASCP) and the commercially trained technologists (79% or over, in all hospital size categories) is thought to be the result of the careful use of code numbers throughout the study and stressing this use to participating workers; the expressed desire by many clinical hospital laboratory personnel to know how well their results compared to control groups results and the expressed wish by many workers that their role in the medical field should gain wider recognition.

Packaging and Coding of Unknowns

Preparing, obtaining, coding, assembling and packaging the unknowns called for the imagination, skill, patience and logistic ability of everyone associated with the project. In order to absolutely insure that each technologist worked upon the unknown assigned to them, each vial, tube, slide, container and reporting form carried an assigned code number. Of course, this meant that, in most cases, each item had to be marked by hand.

Altogether, over 3,000 items were involved in the coding procedures alone. All but the slides were refrigerated before packing (cultures were inoculated just prior to packaging) and packaging took place (149 boxes) on one day. All boxes were refrigerated overnight and were sent the next morning to the hospitals by first-class mail.

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[3] In all, 51 workers were not sent unknowns. 16 MT(ASCP) technologists were engaged in the specialized fields of cytology and histology. Four commercial school technologists were also engaged in specialized activities. The remaining 31 workers in the "other" classification were, for the most part, hired and trained on the job for routine procedures, such as urinalysis.

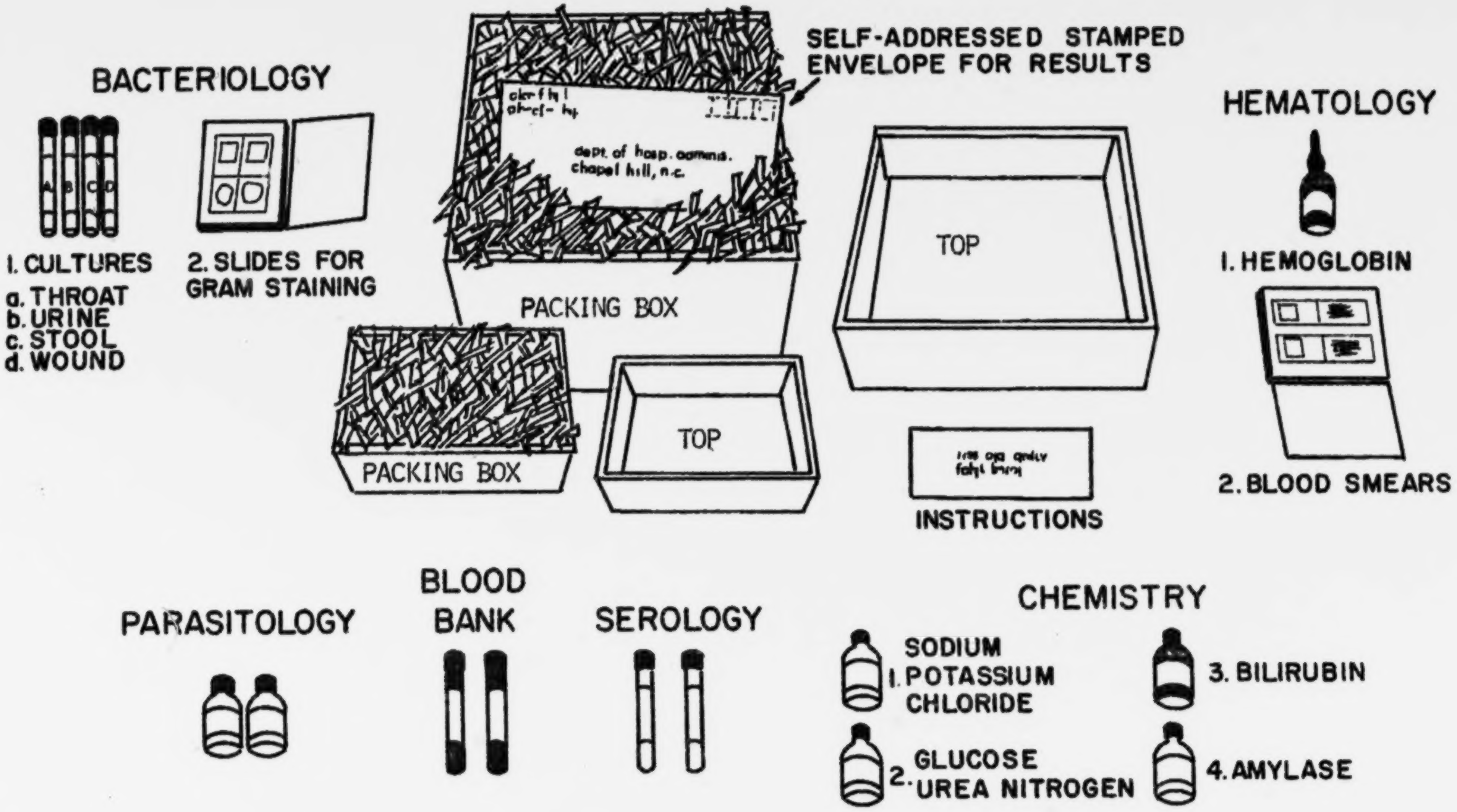
BACTERIOLOGY
I. CULTURES
a. THROAT
b. URINE
c. STOOL
d. WOUND
2. SLIDES FOR GRAM STAINING
SELF-ADDRESSED STAMPED ENVELOPE FOR RESULTS
dept. of hosp. comms.
chapel hill, n.c.
PACKING BOX
TOP
PACKING BOX
TOP
INSTRUCTIONS
HEMATOLOGY
I. HEMOGLOBIN
2. BLOOD SMEARS
PARASITOLOGY
BLOOD BANK
SEROLOGY
CHEMISTRY
SODIUM
I. POTASSIUM
CHLORIDE
2. GLUCOSE
UREA NITROGEN
3. BILIRUBIN
4. AMYLASE

Figure 1

The Field Instruments

In addition to the use of the unknowns, four other field instruments were used to collect data for this study. Complete schedules appear in Appendix C.

1. A self-administered questionnaire for technologists.
2. An interview schedule for technologists.
3. An interview schedule for supervisors.
4. Marked sense, automatic data processing cards for technologists.

A brief description of the purpose and scope of the four instruments follows:

1. A Questionnaire for Laboratory Technologists

This instrument was distributed to the laboratory technologists to complete and return. Items included: how do others in the community view the occupation of laboratory technology; what opportunity does this occupation offer for meeting other people in the community; what types of laboratory settings offer the best opportunity; a self-rating scale for ability and experience; what type of locality is preferable; what localities offer the best professional opportunities; degree of participation of selected list of laboratory activities (such as continuing education, reading journals, etc.); opinion on the ethical standards; degree of commitment to this occupation; automation viewed as a threat or opportunity; choice of specialization versus working in the general field; and professional and social contacts with other hospital employees.

2. An Interview Schedule for Laboratory Technologists

This instrument was administered by an interviewer and asked the following information about the respondent: sex; race; history of past working experiences; interruption in work experiences; factors in choice of this occupation; schooling; description of present living quarters; description of members in present household; description of training; description of responsibilities of household upkeep; description of marital status; citizenship; and finally, the respondent was asked to comment upon a series of characteristics commonly associated with the requirements of this occupation, (1) characteristics acquired before training, (2) during training and (3) after working.

3. An Interview Schedule on the Clinical Laboratory in the Hospital

Administered by an interviewer, this instrument was directed to the laboratory supervisor. If the laboratory supervisor was unable to supply the information, others in the hospital, such as the administrator or the chief of medical staff, were queried. Areas included:

characteristics of the laboratory supervisor; identification of laboratory responsibility; physician use of the laboratory; characteristics of physicians in the hospital; laboratory consultation received; number of technologists (full-time, part-time); manpower requirements for the laboratory; laboratory recruitment methods; laboratory training programs; policy on professional meeting attendance; staff involvement in personnel hiring; laboratory staff involvement in personnel training; laboratory staff involvement in budget allocation; laboratory staff involvement in budget planning; laboratory staff involvement in space allocation and involvement in space planning; starting monthly salary scale; and technical rating of staff.

4. Marked Sense Cards for Technologists

Administered by a person familiar with laboratory techniques, these cards were designed to quickly and accurately secure the following information: (a) whether or not the technologist has ever performed the particular determination in the laboratory; (b) if not, whether the technologist is capable of performing each determination. In addition, all other technical information on each determination secured is needed to evaluate the procedures and methods used. This information includes the media, techniques, methods, instruments and other technical information. The following seven areas of the laboratory are covered in this section: bacteriology, blood bank, chemistry, hematology, histology, parasitology, serology and urinalysis.

VOLUME AND QUALITY OF LABORATORY WORK

Those interested in the characteristics of hospital laboratory workers may be unfamiliar with the amount of work performed in, and the quality of, hospital clinical laboratories. This first section of the report reviews both the output and quality of laboratories without considering the skill, experience and training of individual workers.

Four general conclusions emerge from this review of number and quality of procedures:

1. Regardless of hospital size, laboratory operation, supervision, equipment and personnel training, each hospital laboratory performs the same ratio of tests per bed.
2. Regardless of hospital size and the other factors mentioned above, each hospital has the same ratio of workers per bed.
3. Most measures of quality of laboratory performance (regardless of worker's skill, experience, supervision, etc.) indicate that, as hospital size increases, so does the quality of the work performed.
4. There is an indication that, if automated laboratory methods become efficient and more prevalent, then output per bed will increase and worker per bed will decrease because the areas of laboratory most easily automated make up 7/8ths of the total output.

Hospital clinical laboratory workers perform a variety of determinations (tests) used by physicians to diagnose and treat patients. Of the wide variety of determinations performed, bacteriology, blood bank, chemistry, hematology, serology and routine urinalysis tests are the most common. It is estimated that about 12,300,000 tests in these major laboratory areas were performed in the 134 general hospitals of North Carolina in 1964. Table II describes the distribution of tests according to major laboratory areas and hospital size categories. Figure II graphically describes the distribution.

It was expected that the numer of procedures per bed would increase as hospital bed size increases, but this was not found in the sample results.[4] That is, one would expect that larger hospitals, because they are more efficiently organized, have more automated equipment and more skilled personnel, would perform more determinations per bed than smaller hospitals.

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[4] When the number of procedures per bed were calculated, the number was found to be a constant in all cases. This constant was used to calculate the estimated number of procedures for all hospitals in North Carolina. (See Table II)

Table II

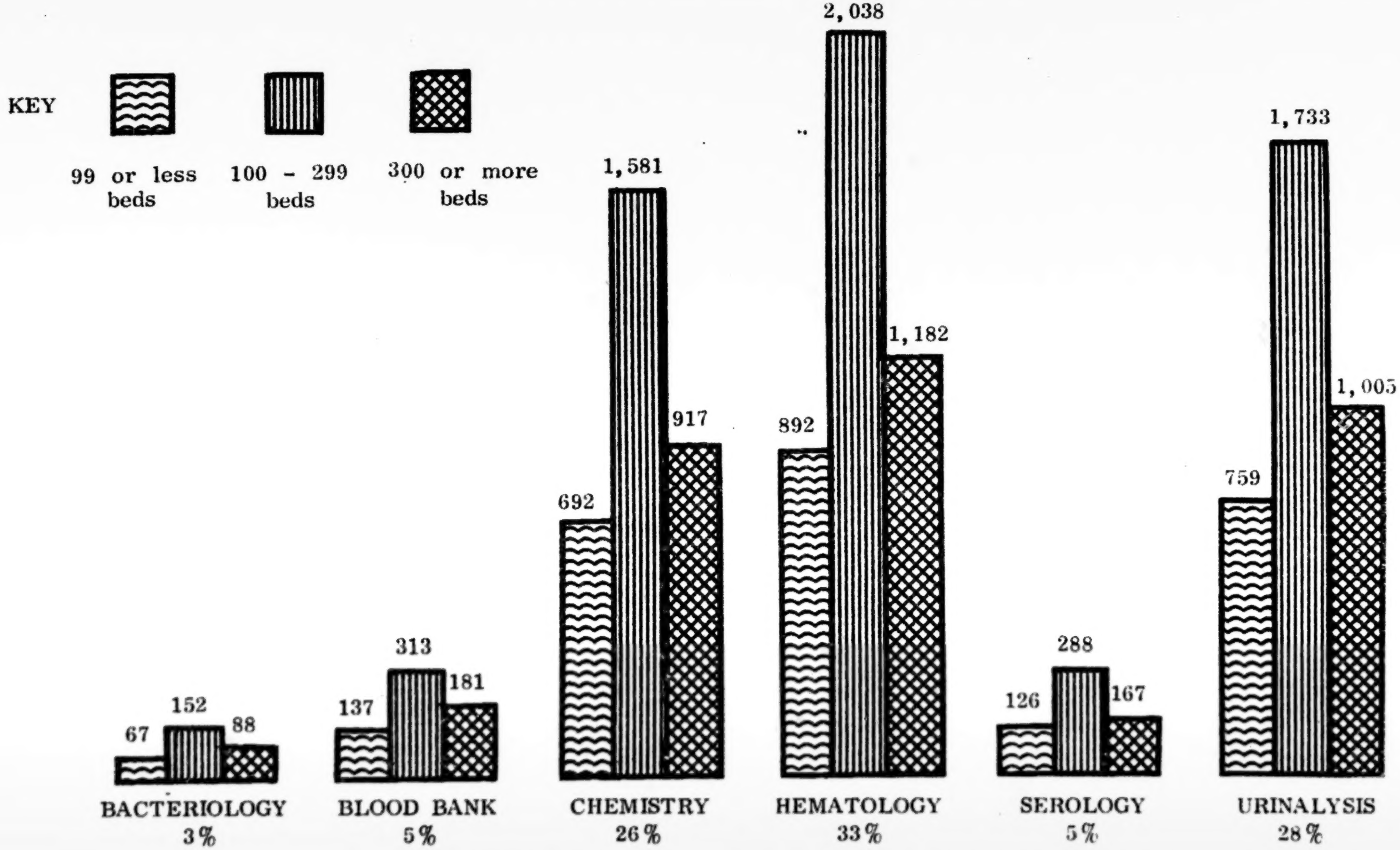
Estimated Number of Laboratory Procedures Performed in Small, Medium and Large North Carolina Hospitals in 1964 (In Thousands)

Bed Size	Total Beds	Bacteriology		Blood Bank		Chemistry		Hematology		Serology		Urinalysis	
		A*	B*	A	B	A	B	A	B	A	B	A	B
99 or Less	3,515	19	66,785	39	137,085	197	692,455	254	892,810	36	126,540	216	759,240
100-299	8,027	19	152,513	39	313,053	197	1,581,319	254	2,038,858	36	288,972	216	1,733,832
300 or More	4,657	19	88,483	39	181,623	197	917,429	254	1,182,878	36	167,652	216	1,005,912
	16,199		307,781		631,761		3,191,203		4,114,546		583,164		3,498,984
			3%		5%		26%		33%		5%		28%
Total	12,327,439												

*A = Average number of procedures per bed, per year (calculated from sample results).
*B = Total estimated procedures (A times number of beds).

Figure 11

ESTIMATED NUMBER OF LABORATORY PROCEDURES PERFORMED IN SMALL, MEDIUM & LARGE NORTH CAROLINA HOSPITALS IN 1964 (IN THOUSANDS)



Total Procedures - 12,327,439

It only can be suggested, from observing large hospital laboratories, that use of automated equipment does not increase the output as much as one would expect because:

(a) highly automated equipment is relatively new and is not efficiently and effectively used as it probably will be in a few years,

(b) although procedures are automated, the reporting of the results from these instruments are not and they are frequently transferred several times (and often by hand) before they finally reach the physician through the patient's chart.

Further implications of automated procedures will be discussed below.

Finally, it may be noted that the following order was observed, when test areas are ranked by frequenty:

Rank	Area	Number	%
1	Hematology	4,114,546	33
2	Urinalysis	3,498,984	28
3	Chemistry	3,191,203	26
4	Blood Bank	631,761	5
5	Serology	583,164	5
6	Bacteriology	307,781	3
		12,327,439	100%

Obviously, hematology, urinalysis and chemistry tests are the most frequently performed tests in hospital clinical laboratories (87%).

With the development of instruments that will automatically count blood cells and other machines that will perform a variety of chemical determinations, both the general areas of hematology and chemistry are, and will be, the most automated areas of laboratory procedures. Although procedures in urinalysis have not been machine automated, fast and simple observational techniques have been developed.

Thus, it would appear that those areas most amenable to automated techniques are the areas in which most laboratory procedures are performed. Therefore, the total nature of laboratories, including manpower characteristics (the general theme of this report) will be considerably altered in the next few years. The current number of procedures performed, accuracy of procedures and manpower characteristics are important, however, in order to chart future requirements in light of new developments.

The present general picture of manpower distributions related to number of procedures is as follows. In 1964, it was determined that just about 1,000 workers were performing laboratory tests in all 134 North Carolina hospitals. Again, it was determined that all hospitals had about the same number of workers per bed; for every 100 beds, there were 6 workers (.06 workers per bed). Relating the number of workers to the estimated number of procedures revealed that each worker performs approximately 50 laboratory determinations per day.[5] Observing this performance by laboratory areas:

Rank	Laboratory Area	Tests Per Day
1	Hematology	17
2	Urinalysis	14
3	Chemistry	13
4	Blood Bank	3
5	Serology	2
6	Bacteriology	1
		50

Anyone familiar with speed and volume of automated laboratory devices now on the market knows that the performance of hundreds of tests per day are possib with the supervision of one trained worker. Again, the probable reason the volume per day per worker is low is related to difficulties involved in using new machinery and the fact that laboratory reporting methods have not been streamlined to handle a greater volume of procedures.

Now in this brief overview of number of procedures and workers, the question of quality of performance is examined.

One method used to determine the quality of work performed in the hospital clinical laboratories in the sample is the grading of unknowns sent to laboratory workers.[6] In all, the following six areas of the laboratory were examined: bacteriology, blood bank, chemistry, hematology, parasitology and serology.[7] Table III and Figures III to IX summarize the results of the unknowns by laboratory areas. It may be noted that the areas ranked by accuracy in the following way:

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[5] Based upon 250 working days per year.

[6] See Appendix A for method of grading unknowns.

[7] It was impractical and too costly to rate technologists on their ability to perform urinalysis procedures.

Table III

Results (in %) of Unknowns from Small, Medium and Large Hospitals

Hospital Size	Accurate	Minimal	Inaccurate
	BACTERIOLOGY		
Small *	11	63	26
Medium	20	64	16
Large *	46	49	5
(All Hospitals)	(22) **	(61)	(17)
	BLOOD BANK		
Small	92	8	0
Medium	91	9	0
Large	100	0	0
(All Hospitals)	(93)	(7)	(0)
	CHEMISTRY		
Small	34	15	51
Medium	37	18	45
Large *	58	21	21
(All Hospitals)	(40)	(17)	(43)
	HEMATOLOGY		
Small	29	49	22
Medium	37	50	13
Large *	78	11	11
(All Hospitals)	(43)	(42)	(15)
	PARASITOLOGY		
Small	32	56	12
Medium	42	51	7
Large *	92	8	0
(All Hospitals)	(46)	(46)	(8)
	SEROLOGY		
Small	57	43	0
Medium	69	31	0
Large	75	25	0
(All Hospitals)	(67)	(33)	(0)

* Chi-square test of association significant (X^2 less than .01)

** Total figures (in parentheses) were used to calculate "expected" frequencies for the Chi-square test of association. Percents for small, medium and large hospitals were "observed".

Figure III

RESULTS (IN %) OF UNKNOWNS FROM ALL HOSPITALS

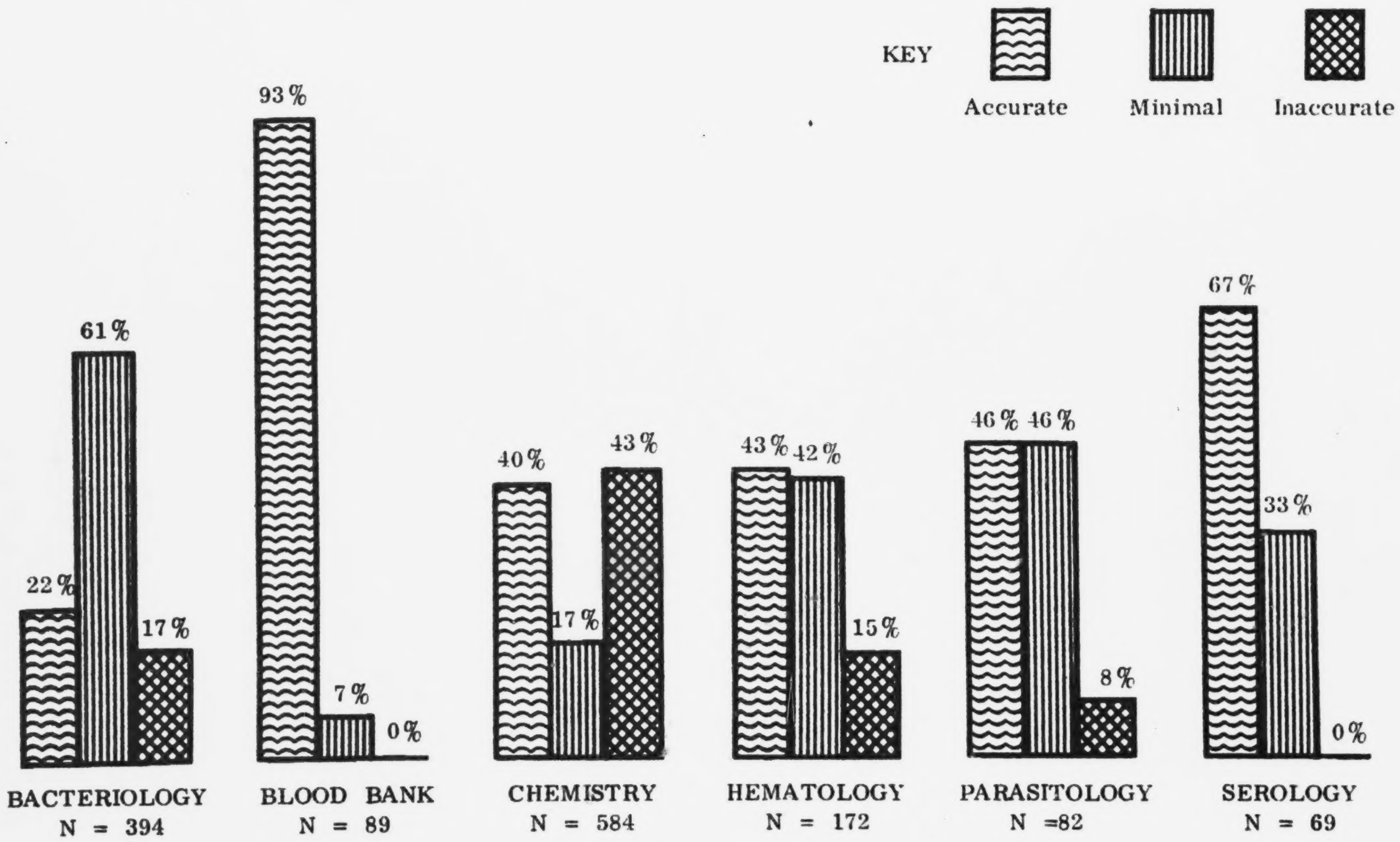


Figure IV

RESULTS (IN %) OF BACTERIOLOGY UNKNOWNS FROM SMALL, MEDIUM AND LARGE HOSPITALS

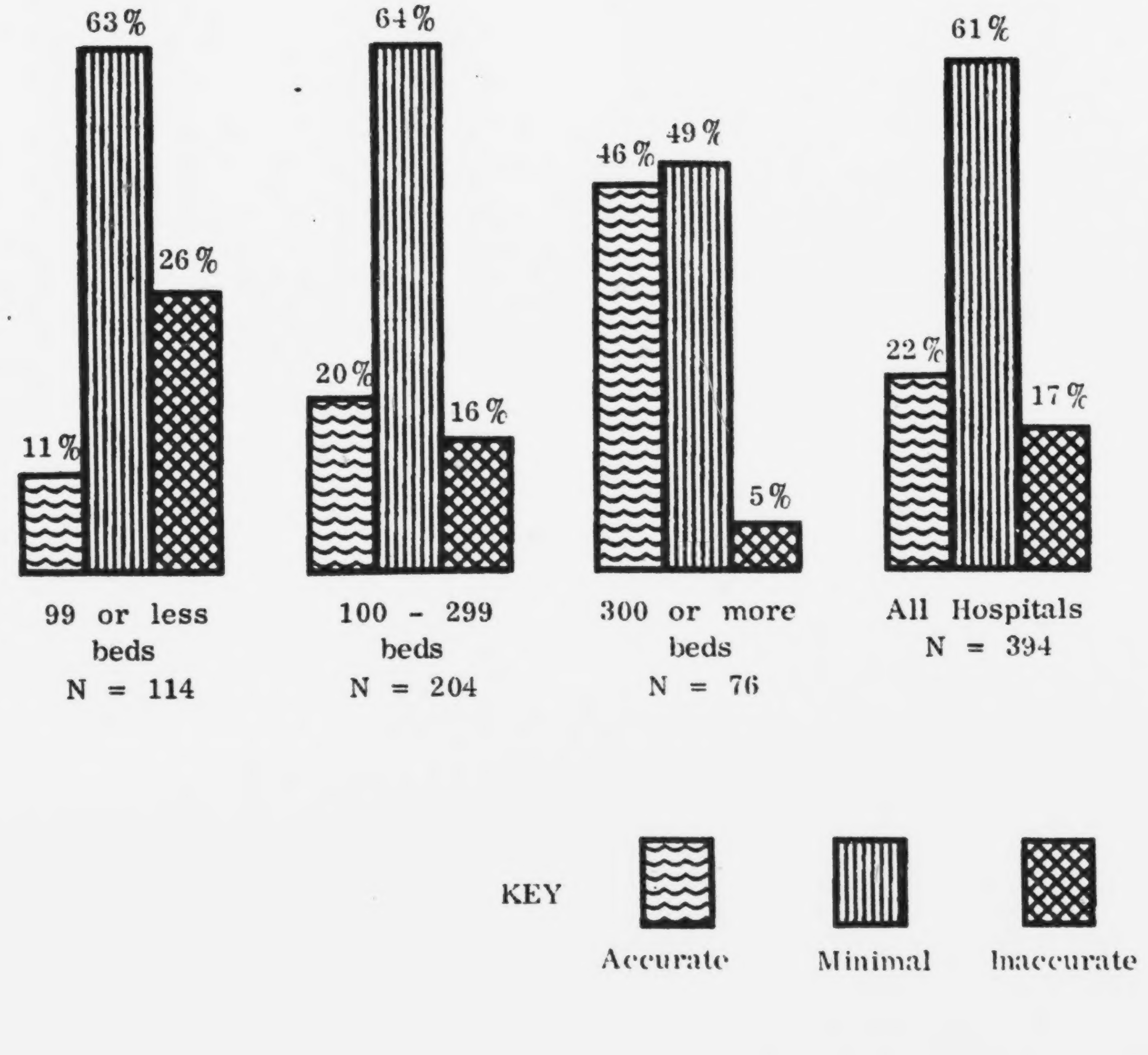


Figure V

RESULTS (IN %) OF BLOOD BANK UNKNOWNS FROM SMALL, MEDIUM AND LARGE HOSPITALS

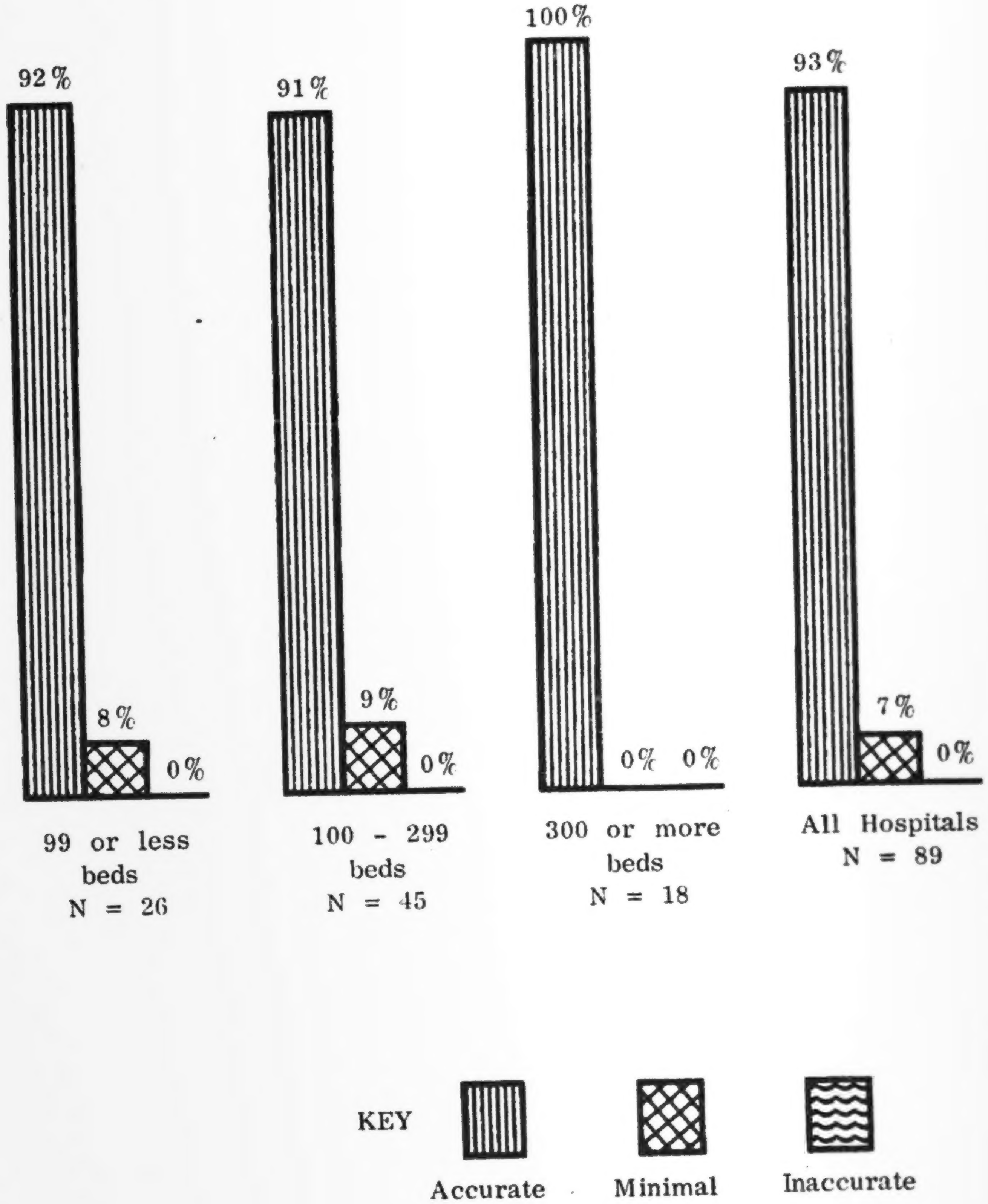


Figure VI

RESULTS (IN %) OF CHEMISTRY UNKNOWNS FROM SMALL, MEDIUM AND LARGE HOSPITALS

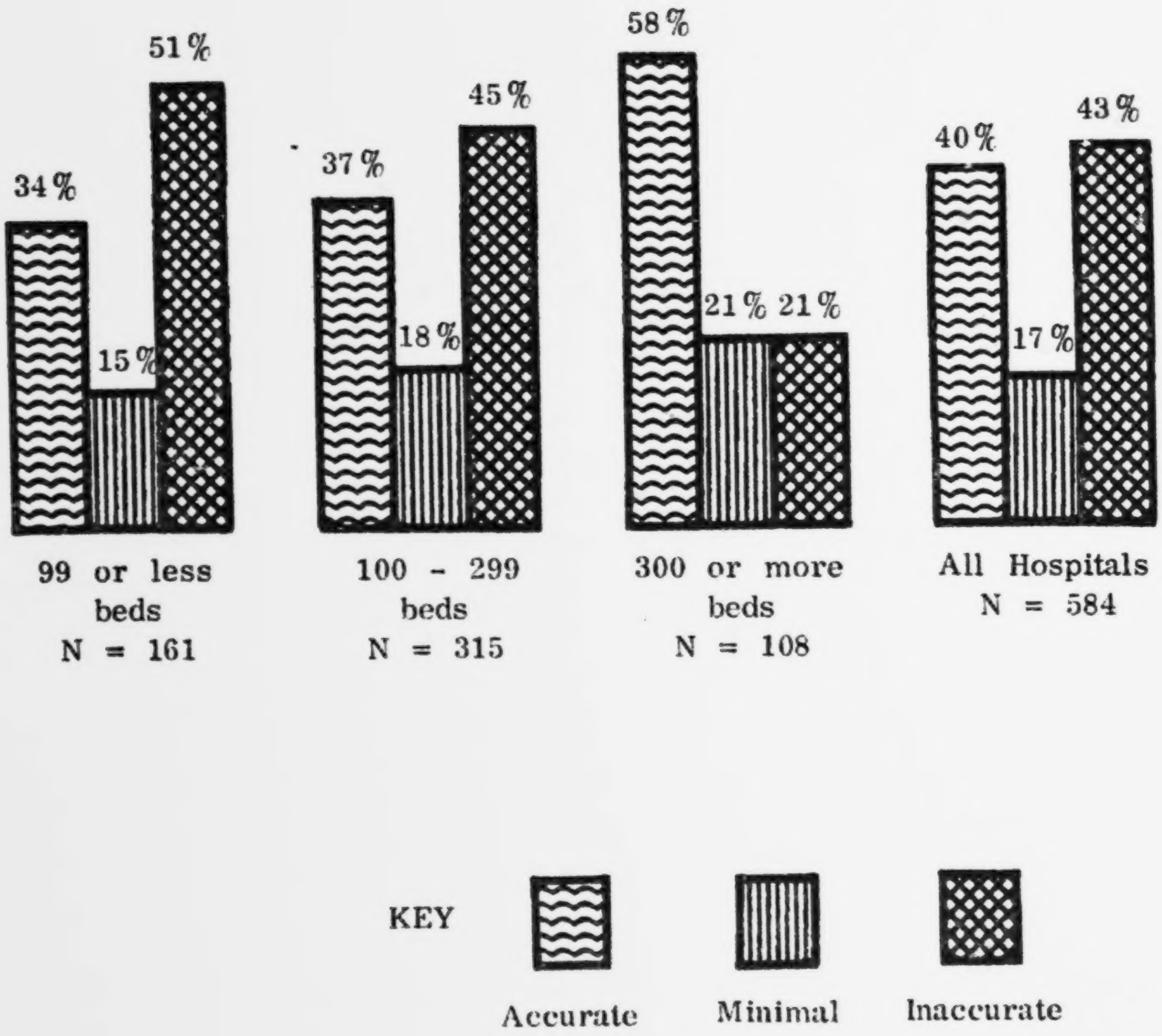


Figure VII

RESULTS (IN %) OF HEMATOLOGY UNKNOWNS FROM SMALL, MEDIUM AND LARGE HOSPITALS

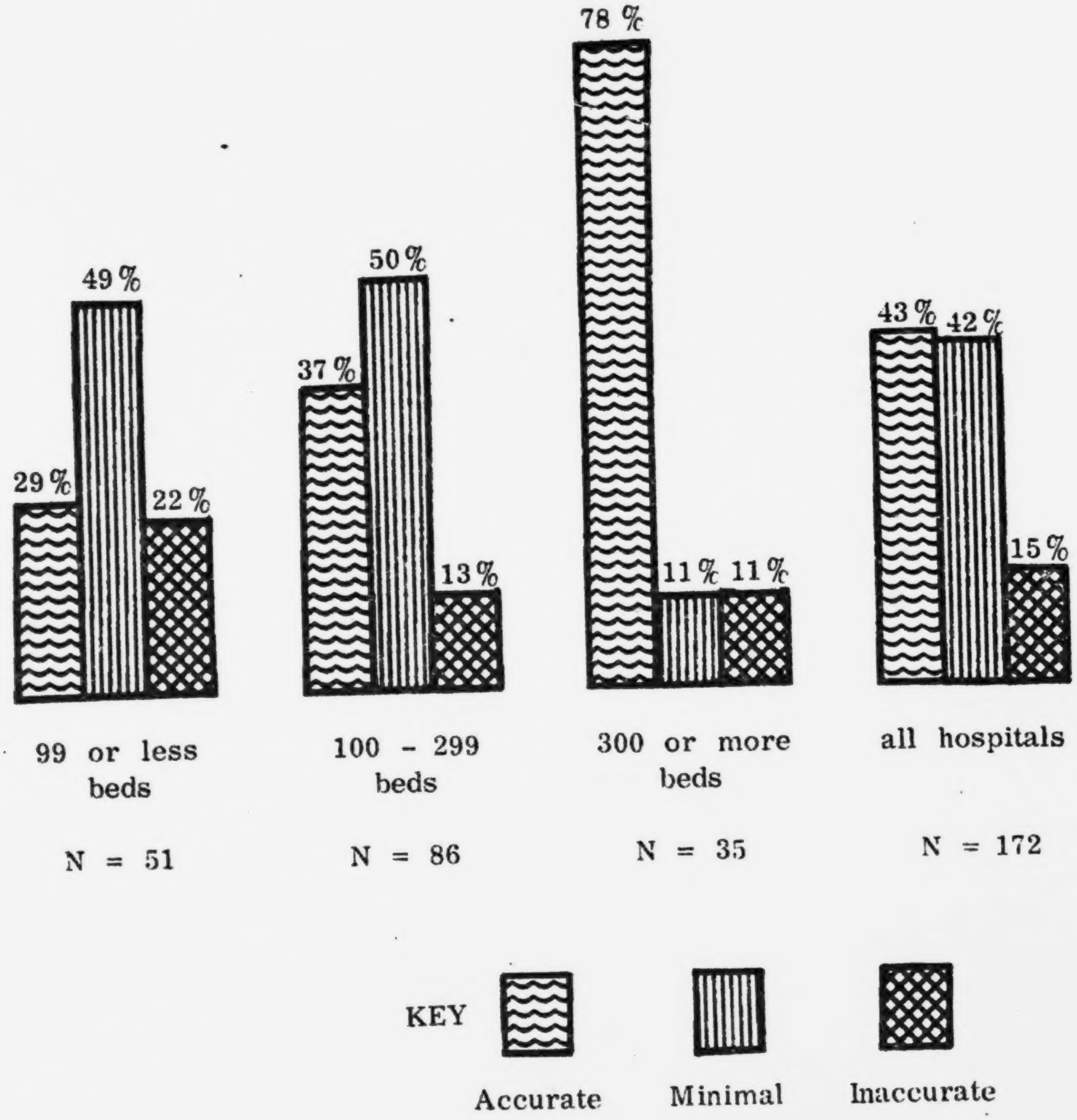


Figure VIII

RESULTS (IN %) OF PARASITOLOGY UNKNOWNS FROM SMALL, MEDIUM AND LARGE HOSPITALS

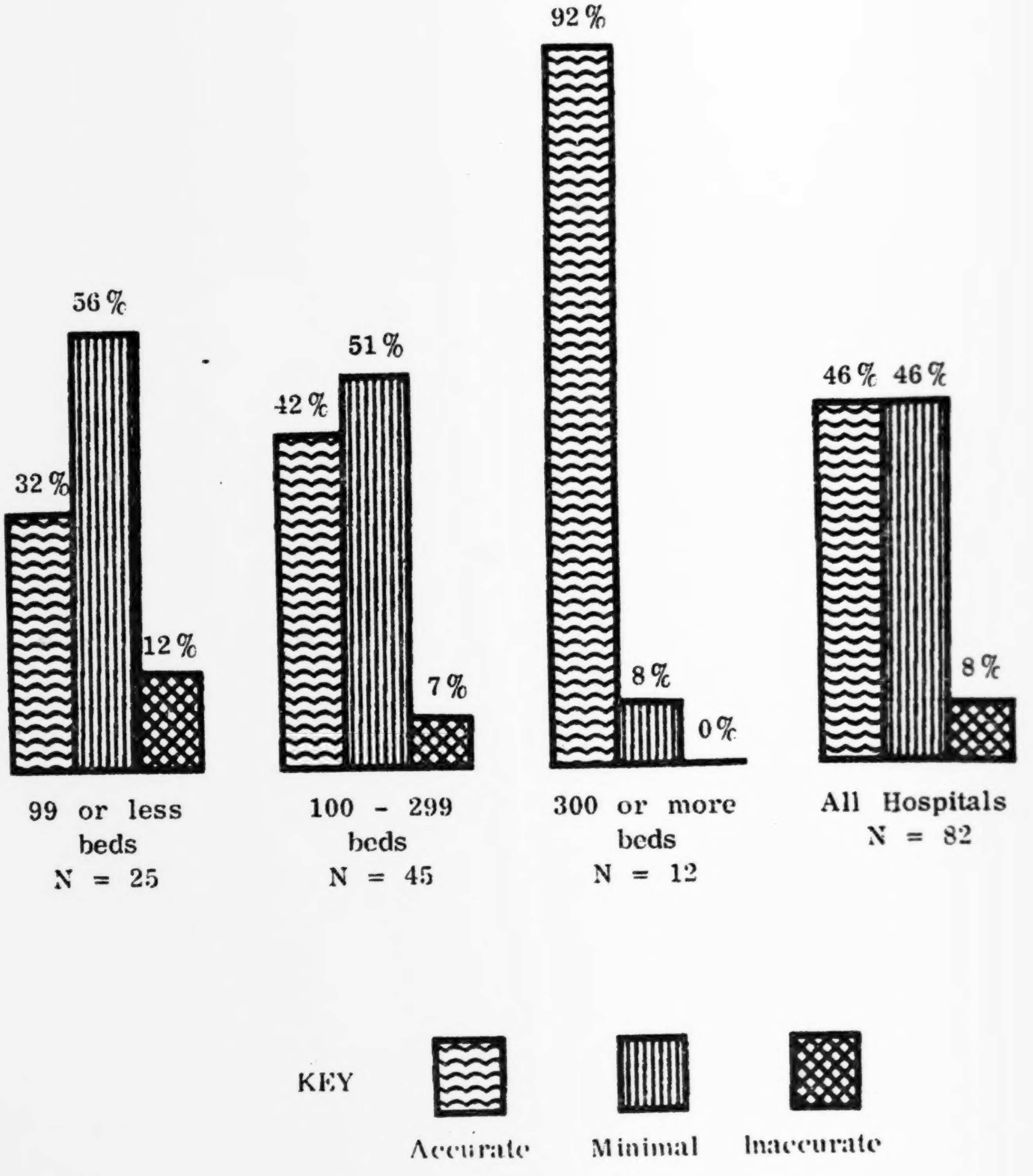
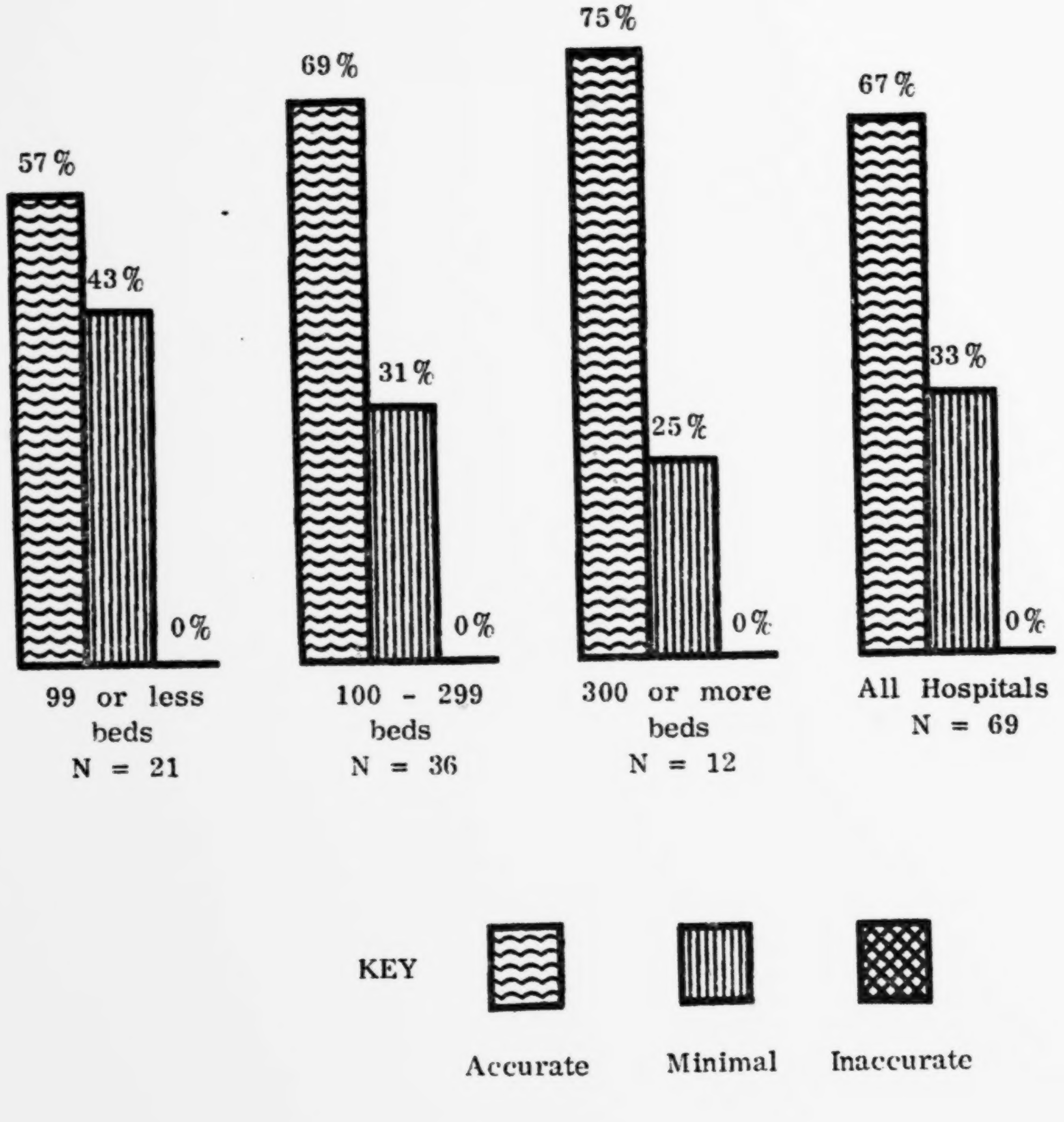


Figure IX

RESULTS (IN %) OF SEROLOGY UNKNOWNS FROM SMALL, MEDIUM AND LARGE HOSPITALS



Rank	Area	*Percent Accurate*
1	Blood Bank	*93%*
2	Serology	*67%*
3	Parasitology	*46%*
4	Hematology	*43%*
5	Chemistry	*40%*
6	Bacteriology	*22%*

Comparing these results with the number and volume of procedures performed, it is estimated that the development of automated procedures in hematology and chemistry will improve results in these areas in the future. Thus, it is probable that, in the next few years, most of the chemistry and hematology laboratory procedures will be more accurate. However, the lack of accuracy in the relatively few bacteriology procedures performed, of course, should not be minimized. Accurate and fast results from bacteriology specimens are crucial for the diagnosis and treatment of infectious diseases.

Turning now to results in particular areas by hospital size category, it is apparent that in several areas results from large hospitals were more accurate than results from small hospitals. This will be discussed more fully below, as each hospital size category is completely described.

Another general assessment of the hospital clinical laboratory was made using a composite criteria[8] and rating laboratory areas poor, average and excellent. Results of this rating appear in Table IV. It is readily noticeable that, by the use of this criteria, small hospitals, generally speaking, are poor or at best average; medium sized hospitals rate average to excellent and large hospitals ranked excellent. Each hospital was ranked and compared by its rank in size.[9]

A further measure of quality in laboratory performance can be made by comparing laboratories on the basis of how often "standards" and "controls" are used. To assure that laboratory instruments, chemical reagents and techniques are accurate and reliable, known chemical values (standards and controls) are tested right along with the patient specimens. As long as the test results from the controls and standards match what is known to be accurate, then there is an assurance that the patient specimens are being accurately assessed.

The daily use of standards and controls can only be viewed as a minimal check on instruments, reagents and techniques and anything less than the daily use of both controls and standards must be viewed as inadequate.

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[8] See Appendix B for method of rating laboratories.

[9] The Spearman co-efficient of rank correlation was .86.

Table IV

Clinical Laboratory Ratings by Small, Medium and Large Hospitals

	BACTERIOLOGY			BLOOD BANK			CHEMISTRY			HEMATOLOGY			ALL AREAS		
	Poor	Aver	Excel	Poor	Aver	Excel	Poor	Aver	Excel	Poor	Aver	Excel	Poor	Aver	Excel
Small 99	8	3	1	5	7	-	9	2	1	6	6	-	28	19	1
Medium 100-200	2	5	5	2	4	6	1	2	9	-	6	6	5	17	26
Large 300	-	-	3	-	-	3	-	-	3	-	-	3	-	-	9

Table V reports on the variations in use of standards and controls by hospital bed size categories. Here it is noted that small and medium size hospitals do not always use daily standards and controls in chemistry, hematology and serology, whereas larger hospitals always employ daily standards and controls.

Hospital laboratories have a variety of instruments for testing patient specimens. In general, as indicated in Table VI, the ownership of major specialized kinds of equipment increases as hospital size increases. The automatic cell counter and the automatic chemical analyzer are usually considered as "automated" equipment. As indicated above, this equipment is used in those laboratory areas in which most procedures are carried out - hematology and chemistry.

Table VI

Small, Medium and Large North Carolina Hospitals Using Specialized Laboratory Equipment, 1965

Beds	Equipment *					
	A	B	C	D	E	F
99 or Less	All	1/2	None	None	None	None
100-299	All	All	1/2	1/4	1/2	1/2
300 or More	All	All	All	All	All	All

* A = Colorimeter and/or Spectrophotometer
B = Flame Photometer
C = Microgasometer
D = Electrophoresis Apparatus
E = Automatic Cell Counter
F = Automatic Chemical Analyzer

Table V

Frequency of Use of Standards and Controls in Chemistry, Hematology and Serology by Small, Medium and Large North Carolina Hospitals

STANDARDS

Hospital Beds	Chemistry		Hematology		Serology	
	Used Daily	Less Often	Used Daily	Less Often	Used Daily	Less Often
99 or Less	8	6	5	9	7	7
100-299	8	4	2	10	8	4
300 or More	3	-	3	-	3	-
TOTAL	19	10	10	19	18	11

CONTROLS

Hospital Beds	Chemistry Used Daily	Chemistry Less Often	Hematology Used Daily	Hematology Less Often	Serology Used Daily	Serology Less Often
99 or Less	10	4	9	5	11	3
100-299	12	-	8	4	11	1
300 or More	3	-	3	-	3	-
TOTAL	25	4	20	9	25	4

ESTABLISHING FOUR CATEGORIES OF HOSPITAL CLINICAL LABORATORIES

Introduction

Early in the design of this study of hospital clinical laboratories, it became clear that many factors beyond the training, experience and background of individual workers are related to the quality and accuracy of laboratory output. Thus, a total assessment of laboratory activities was made, including procedures, supervision and equipment in order to fully describe the work setting and laboratory quality.

As the analysis of the findings proceeded, it developed that the general assessment of the clinical laboratories provided a means by which hospitals could be categorized. In turn, it developed that four hospital categories emerged. These are used in the next section to describe individual worker's training, experience and background. This section describes the method used to assess the clinical laboratories ending with the establishment of four hospital categories.

The Criteria of Quality

Seven criteria were established from the study findings, each a separate measure of laboratory quality. The criteria include:

1. Instruments - Use of specialized laboratory instruments including flame photometer, microgasometer, electrophoresis apparatus, automatic cell counter and automatic chemical analyzer.
2. Operations - Methods of procedure, record keeping, instrument calibration and use of equipment.
3. Supervisor - Training, education and experience of supervisor.
4. Pathologists - Number of attending pathologists and amount of coverage (full-time, part-time).
5. Unknowns - Average score computed for each laboratory from the results of unknowns sent out and received during the study period.
6. % MT(ASCP) - Percent of laboratory workers certified, as Medical Technologist by the American Society of Clinical Pathologists.
7. Standards and Controls - Use, and frequency of use, of standards and controls.

Ranking of Hospitals

Twenty-eight of the study hospitals were ranked by each of the criteria. Since each ranking constitutes a separate "judging" of hospital quality, a co-efficient of concordance was computed and found to be significant.[10]

Because the statistical test of relationship was significant, the ranking method was used to construct hospital categories which will be described below. At the same time, each quality measure was compared with one another by computing the rank correlation co-efficient (R).[11] The results of this comparison appear in Table VII.

Table VII

Rank Correlation Co-efficients Between Seven Criteria of Quality and Bed Size for 28 North Carolina Hospitals

	Instruments	Operations	Supervisor	Pathologist	Bed Size	Unknowns	% MT (ASCP)
Operations	.77						
Supervisor	.76	.75					
Pathologist	.79	.78	.66				
Bed Size	.79	.88	.76	.78			
Unknowns	.59	.65	.73	.63	.49		
% MT(ASCP)	.71	.65	.70	.56	.50	.65	
Standards & Controls	.52	.41	.46	.47	.32*	.50	.41

* Not Significant

It will be recalled that a perfect, positive relationship between two ranking methods is expressed by 1.0 and the absence of relationship by zero. All but one of the ranking methods are statistically significant. It must also be remembered that the existence of relationship between two ranking methods only means that the two methods of ranking hospitals yield about the same results. Only a tentative inference can be made that the two criteria are related to each other.

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[10] W = .64, P is less than .01.

[11] Bed size was not used to compute W, but was included in the rank correlation co-efficient "matrix" so its relationship to the other measures may be examined.

Upon closer examination of the various rank correlation co-efficients, it may be noted that those criteria which appear to be closer in agreement with one another are instruments, operations, supervisor and pathologist, while those with lesser agreement are bed size, unknowns, % MT(ASCP) and standards and controls. Some would argue that the only "true" measure of quality here is the output of the laboratory, in this case the results of the unknowns, but it was felt that the interaction of all these measures yielded a true measure of quality. However, if one wishes to view the results of the unknowns as an "independent" measure of laboratory quality, then it will be noted that the "dependent" measure of supervisor most closely agrees followed by % MT (ASCP) and operations.

Somewhat surprising is the result of the ranking by standards and controls, which did not have close agreement with the other measures of quality. Further, when hospital size ranking is related to standard and control ranking, the results are not significant. Those familiar with clinical laboratory procedures are well aware that the daily use of standards and controls are rather inexpensively and easily implemented and both are instrumental steps in assuring that laboratory results are accurate. One would expect that, when hospitals are ranked either by size, supervisor or pathologist, a ranking by use of standards and controls would closely agree but, as shown, did not.

Reviewing those criteria which were most related to one another, the criteria of instruments (available, automated equipment) would appear to be a fast and rather easy method to rate clinical laboratories. On the other hand, the criteria of pathologist, too, is not difficult to determine and was more closely related to the results of the unknowns than the instrument criteria.

Finally, some word should be mentioned about the operation criteria and the close agreement this ranking had with ranking by bed size.

If a relationship is inferred between these two criteria of measurement, then it would appear that larger hospitals have instituted more accurate procedures, better reporting methods, regular calibration of instruments and more suitable use of equipment than smaller hospitals.

All seven measures of quality were used to develop four distinct hospital categories in the following way. The mean score of the seven ranks were computed for each hospital and these means were plotted against hospital bed size. The following picture of hospital clinical laboratory quality by bed size emerged.

Category	Number of Hospitals	Bed Size	Quality (Mean Score)
I	3	300 or More	High
II	6	100 - 299	Medium
III	6	100 - 299	Low
IV	13	99 or Less	Low

These, then are the four categories which will be used in the next section to describe the individual characteristics of the laboratory workers. Of course, special attention will be given to categories II and III, for here emerged two distinct qualities of performance in essentially the same size hospitals.

THE WORKER

Introduction

This section, which examines the characteristics of laboratory workers in their work setting, begins with a general review of the characteristics of all workers, regardless of hospital size or laboratory quality.

General Characteristics of All Workers

The social and economic characteristics, as well as some attitudes and activities of the almost two hundred laboratory workers interviewed in this study, are summarized in Figures X - XIII. Briefly reviewing these findings, it may be noted that three training groups are almost equally represented (as intended by the method of sample selection): those workers trained in schools which have been certified by the American Society of Clinical Pathologists; workers who have trained in Commercial Schools; and those workers who have received no formal training but have been trained on-the-job.

Over 85% of the workers are female, about half of whom are married. More workers are over 30 years of age than under and more than half the workers receive less than $400 a month. About half of all workers have been working five years or more and almost two-thirds regard this as a permanent career. Workers are about equally divided between those who feel they can move to another job, if a better opportunity presents itself, and those who feel they have little job mobility.

Two-thirds of the workers feel the best job opportunities are found in a small or medium sized town, while the remaining third felt that the best opportunities for work are in metropolitan centers. Most of the workers said their occupation helps them become acquainted with others in the community, but all agreed almost no one in the community understands the kind of work they do and a third of the workers felt that others in the community did not even know about the occupation. The majority of workers only occasionally have an opportunity to take courses, attend professional meetings or associate with others outside the hospital in their profession. Compared to these activities, more workers are called upon to instruct others. Almost three-quarters of the workers interviewed stated that they read professional journals regularly.

In general, then, the sample is made up of mostly female workers over 30 years of age with a great amount of variation in training. Half are married and half have had considerable working experience, but most earn less than $5,000 annually. Many say they are committed to the occupation, but half

(Continued on page 36)

Figure X

SUMMARY CHARACTERISTICS OF LABORATORY WORKERS

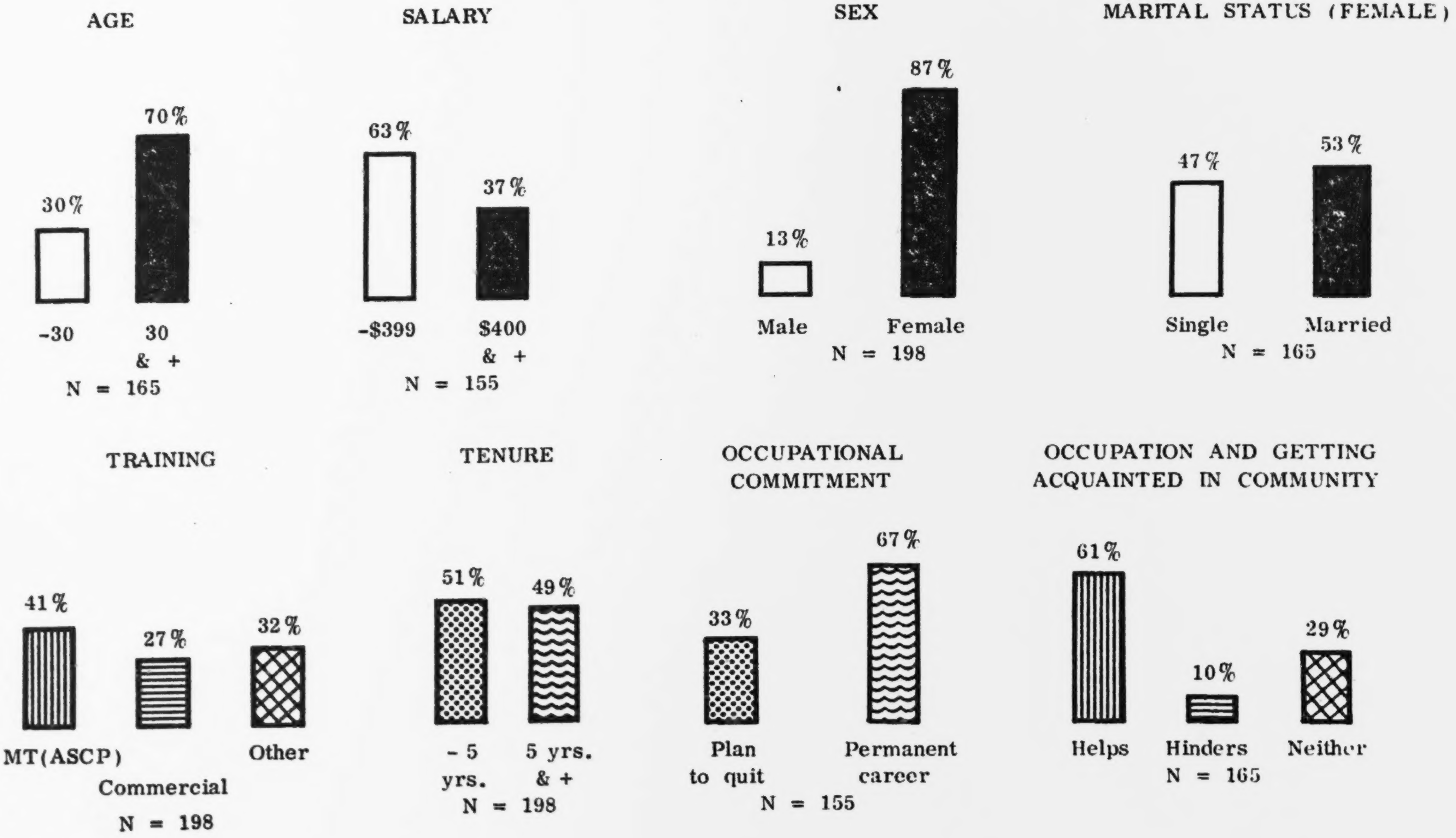


Figure XI

SUMMARY CHARACTERISTICS OF LABORATORY WORKERS

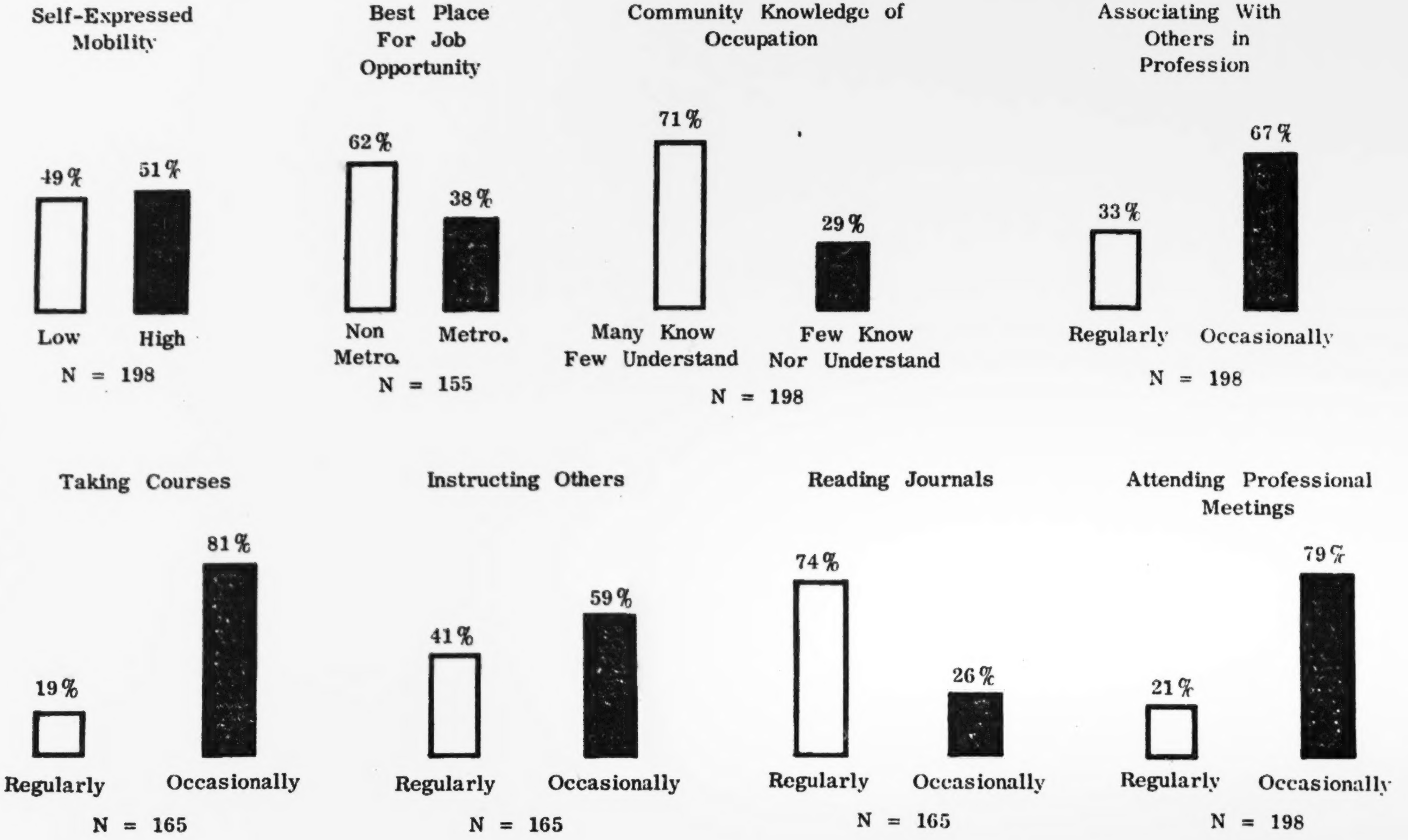


Figure XII

GENERAL CHARACTERISTICS OF WORKERS BY HOSPITAL SIZE

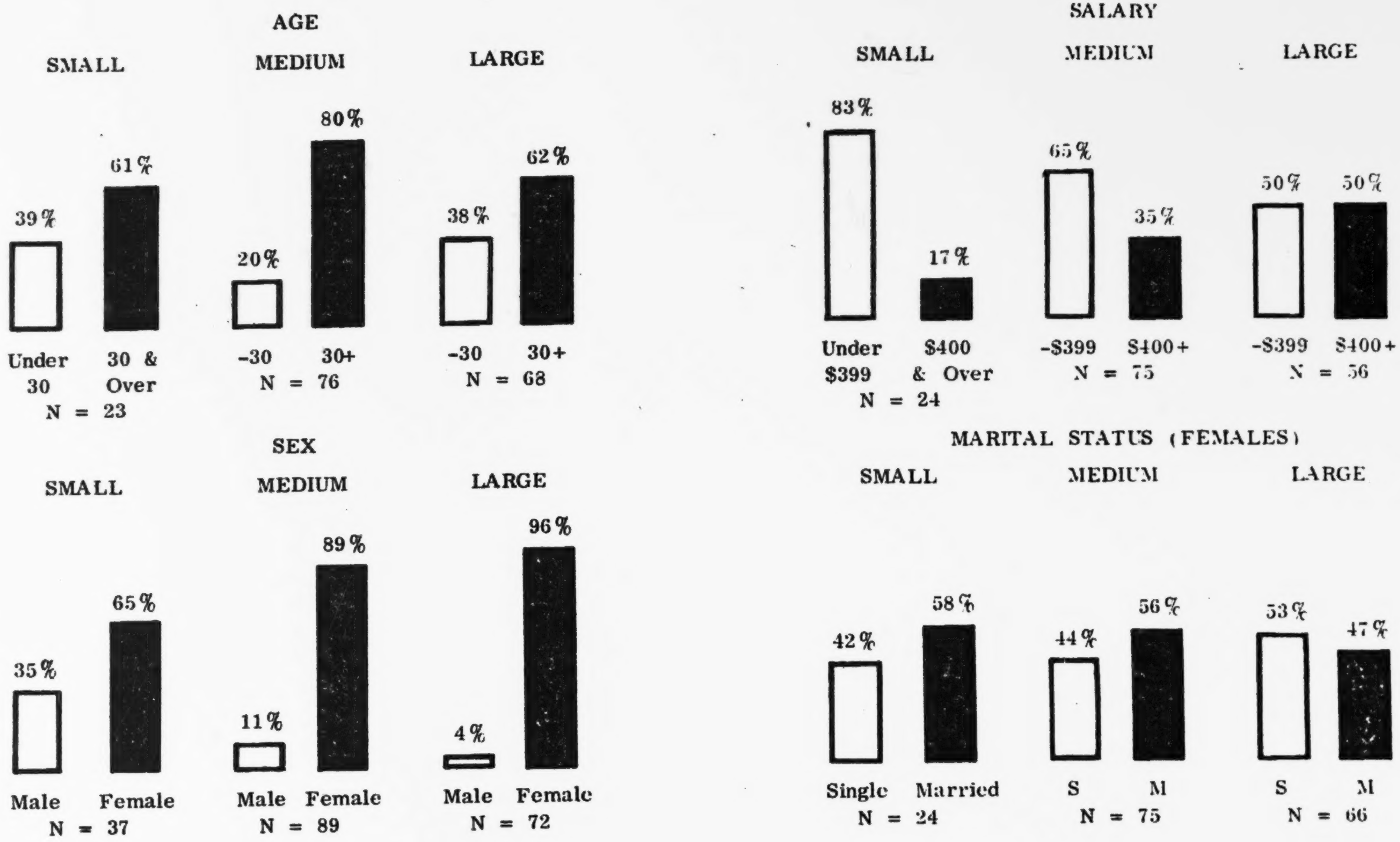
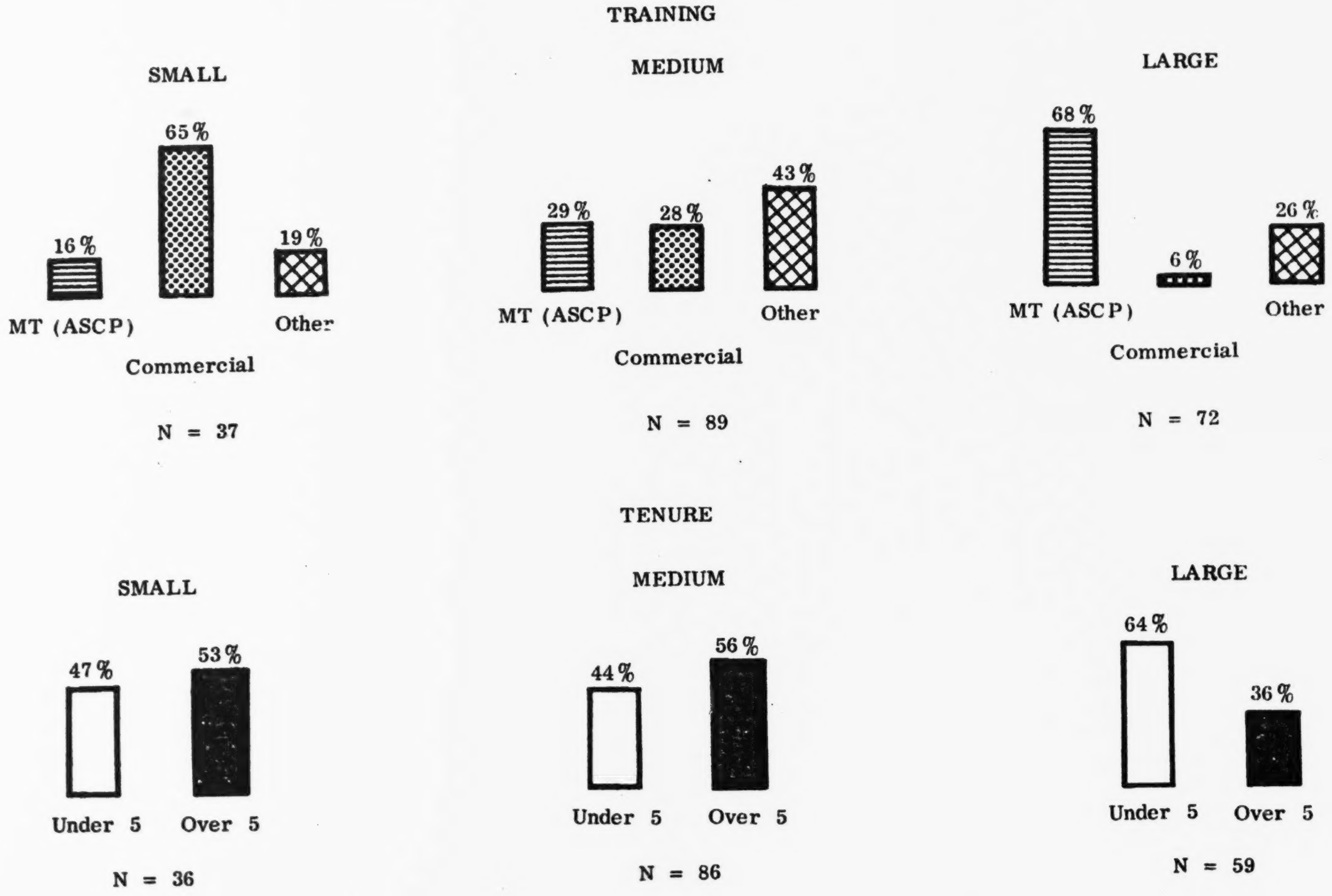


Figure XIII

GENERAL CHARACTERISTICS OF WORKERS BY HOSPITAL SIZE



feel they cannot move for a better job opportunity. Despite the lack of knowledge community members are said to have about the occupation, most workers feel their jobs help them become acquainted in the town or city. Finally, except for reading journals and instructing others, most workers do not engage in the kind of continuing education activities usually associated with professional occupations.

Are there any special traits or requirements needed to become a laboratory technologst? According to 194 reponses from a question in this area, only two specialized requirements emerge: manual dexterity and the ability to discriminate colors accurately. Prior to the field investigation, recruitment literature was gathered from state health departments, state employment agencies and the like. From job descriptions and requirements, a list of 27 items was drawn up and placed on 3 x 5 cards. These cards were given to the technologists during the interview and they were asked to sort them into three piles: those traits that are required before training; those traits that are acquired during training and those traits that are only learned after working experience.

Tables VIII, IX and X list the rank order of the responses from the cards: the first items were selected most often and the last items least often. Except for manual dexterity and color discrimination, the first ten items on Table VIII obtain for any service oriented career.

It is during the training period that the technician begins to select items related to the importance of specific occupational techniques. Here, adjusting to those in the working environment and adjusting to the environment itself (tolerating odors, for example) becomes important.

After the training period, when the techniques of laboratory work are mastered, a next set of traits come to the top in Table X. Most of the items here (except for the first one) are related to maintaining a social and professional equilibrium: operating under pressure; working in the emergency situation; spotting the usual condition; appearing on call; are all conditions which appear to chip away at the routine of work and emerge as the characteristic traits and conditions important when one is on the job.

The first item (record keeping for supplies and equipment), however, does not fit into the category of the others and demands special mention. Quite obviously, technologists do not receive much training in this area but apparently feel that this ability is most important once one is on the job.

In one sense, then, the first ten items or so are a brief history of the kinds of situations and conditions that technologists face as they move from recruitment through training to the on-the-job position.

For some, the occupation of laboratory technology may provoke the image of a white coated figure, silently and lonely working out the days in the isolation of an anticeptic laboratory. Observation of laboratory settings

Table VIII

Rank Order of Response to Characteristics Required Before Training

1. Be devoted to serving mankind.
2. Have "alert intelligence".
3. Be able to concentrate.
4. Be very dependable.
5. Have an investigative mind.
6. Have manual dexterity.
7. Be able to discriminate colors accurately.
8. Be able to perform arithmetic calculations quickly.
9. Be able to admit an error has been made.
10. Get along well with co-workers.

11. Enjoy laboratory work.
12. Make accurate notes and reports.
13. Be willing and able to follow-up on minor details.
14. Have theoretical knowledge.
15. Be able to tolerate unpleasant odors.
16. Be able to follow detailed procedures accurately.
17. Have compassion for sick and still carry out duties.
18. Be able to remain calm and react immediately in an emergency.

19. Be able to work under pressure.
20. Get along well with patients.
21. Be able to recognize unusual conditions.
22. Get along well with physicians.
23. If needed on call, appear for work despite personal circumstances.
24. Get along well with administrator.
25. Have ability to determine and keep records on equipment and supply costs.
26. Be able to get along with nurses.
27. Be able to work in presence of patients.

Table IX

Rank Order of Response to Characteristics Acquired During Training

1. Be able to work in presence of patients.
2. Be able to follow detailed procedures accurately.
3. Be able to get along with nurses.
4. Get along well with patients.
5. Be able to tolerate unpleasant odors.
6. Get along well with physicians.
7. Have theoretical knowledge.
8. Make accurate notes and reports.
9. Be able to recognize unusual conditions.
10. Enjoy laboratory work.

11. Be able to work under pressure.
12. Be willing and able to follow-up on minor details.
13. Have compassion for sick and still carry out duties.
14. Be able to remain calm and react immediately in an emergency.
15. Get along well with co-workers.
16. Get along well with administrator.
17. Be able to discriminate colors accurately.
18. Be able to admit an error has been made.

19. Be able to perform arithmetic calculations quickly.
20. If needed on call, appear for work despite personal circumstances.
21. Have manual dexterity.
22. Have ability to determine and keep records on equipment and supply costs.
23. Be able to concentrate.
24. Have an investigative mind.
25. Be very dependable.
26. Have "alert intelligence".
27. Be devoted to serving mankind.

Table X

Rank Order of Response to Characteristics Learned After Working Experience

1. Have ability to determine and keep records on equipment and supply costs.
2. Get along well with administrator.
3. Be able to remain calm and react immediately in an emergency.
4. If needed on call, appear for work despite personal circumstances.
5. Be able to work under pressure.
6. Be able to recognize unusual conditions.
7. Have compassion for sick and still carry out duties.
8. Get along well with physicians.
9. Be able to get along with nurses.
10. Get along well with patients.

11. Be able to work in presence of patients.
12. Be willing and able to follow-up on minor details.
13. Get along well with co-workers.
14. Be able to admit an error has been made.
15. Be able to follow detailed procedures accurately.
16. Have theoretical knowledge.
17. Be able to tolerate unpleasant odors.
18. Enjoy laboratory work.

19. Make accurate notes and reports.
20. Be able to perform arithmetic calculations quickly.
21. Be very dependable.
22. Have an investigative mind.
23. Have manual dexterity.
24. Be devoted to serving mankind.
25. Be able to discriminate colors accurately.
26. Be able to concentrate.
27. Have "alert intelligence".

and responses to questions designed to investigate social and professional interaction lead to one general conclusion: while working in the occupation may not demand a gregarious personality almost unlimited opportunities abound for professional and social contacts within the hospital.

The Worker in the Small Hospital

In North Carolina, as well as in the entire Nation, one hospital bed out of every five is found in the small hospital (99 beds or less). On the basis of the volume of patient care alone, the smaller hospital cannot be brushed aside as an unimportant feature of the medical landscape. Furthermore, since it has been demonstrated that bed size is apparently related to laboratory output, it is estimated that 20% of all laboratory tests performed[12] are carried out in the small hospital. If one were to be unconcerned about the quality of laboratory performance and remain interested only in the volume of output, it would appear that smaller hospitals are in the most favorable position to maintain and recruit workers to sustain the present laboratory work volume levels.

In the smaller hospital, almost 85% of the workers have been trained in commercial schools or on the job.[13] Almost the same number are paid $399 or less a month. Despite these relatively low salary scales, three-fourths of the workers in the small hospitals expressed a commitment to their occupation. Only half the workers in large hospitals expressed a commitment to the occupation - the other half plan to leave the occupation. When worker turnover does occur, it would appear that new, quickly trained, low salaried replacements are available. The supply of commercial school graduates will probably continue to be adequate, since few large hospitals hire these workers. As long as hospitals are willing to train their own workers, the supply of untrained female high school graduates must be almost limitless, particularly if part-time workers are employed.

This study, however, has not been exclusively devoted to the number and kinds of laboratory workers but has focused upon the quality of laboratory output. It has been determined that small hospital laboratories rate lower than half the medium and all the large hospitals in the sample in terms of quality of total performance. It has been further determined that many of the laboratory procedures, which require advanced training and sophisticated technical skills were inaccurately performed by workers from the smaller hospitals. On the other hand, much of the work performed in any hospital laboratory can be labelled "routine" and, for the most part, this work is apparently carried out in satisfactory manner in most hospitals.

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[12] In short-term, general hospitals.

[13] Figures XII and XIII describe characteristics of workers in small hospitals.

If one were to be concerned about the quality of output in the smaller hospital laboratory, then the findings of this study would suggest two alternate courses of action related to the training and supply of manpower.

One course of action would be to suggest methods by which workers in each hospital laboratory could accurately perform a rather broad range of tests, including those that require advanced training and skills. An alternative course of action would be to suggest methods which would restrict the range of procedures performed in smaller hospital laboratories so that the controlled output of workers with limited training would be accurate and reliable.

Either alternative of action has ramifications which go beyond the training and supply of workers and reach into the organization of the laboratory and the delivery of health care to patients.

The first alternative, assuring a broad range of tests are accurately performed in the small hospital, is the one which would least upset the present patterns of delivering patient care. The very existence of small hospitals throughout this country is a testimonial to desires of physicians, patients and their families that health care should be delivered as close to home as possible. Numerous attempts to establish regional health centers, strong patient referral patterns and the general consolidation of medical services have met with heavy, consistent and successful resistance by medical organizations and community groups.[14]

Of course, some laboratory tests can be performed miles away from the hospital (and, in many cases, they are) without a detrimental effect upon the patient. If physicians and patients insist, however, that the present, rather broad range of cases are going to be diagnosed and treated in the small hospital, then that hospital laboratory must be equipped to supply the physician with a rather complete (and continually expanding) range of laboratory tests, the results of which, of course, must be quickly and accurately available.

One of the first challenges facing the improvement of the laboratory in the small hospital is the organization of the laboratory itself. In this study, more varieties of laboratory organization and methods of supervision were found in the smaller laboratory than in medium-sized or large hospitals. Medical supervision of these laboratories was found to range from the chief of the medical staff (commonly a monthly, rotating position) to a particular physician who has developed a special interest in laboratories (most often those with an interest in hematology). When the services of a pathologist are available, they are usually always part-time men who visit the hospital briefly once a week or once or twice a month.

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[14] The most recent successful challenge to a "rational" plan of highly concentrated medical care centers is the modification of the original Heart, Cancer and Stroke Regional Medical Center by the DeBakey Committee to the now established Heart, Stroke and Cancer Regional Medical Program, Public Law 89-239.

It would not be realistic to suggest that each small hospital in the country be under the supervision of a full-time pathologist. Everyone in the health field knows that there is a critical shortage of pathologists across the country and no solution to alleviate this shortage is in sight.

If small hospitals are to receive the medical leadership and supervision from the pathologists needed for a broad range of patient care, then more effective methods to utilize the existing supply of pathologists must be found and established. Perhaps it is even more important that published guidelines for the part-time pathological services be established and adopted.

As the interviewers moved from one small hospital to another during the field investigation, it soon became apparent that the range of "part-time" services offered by the pathologist varied greatly. In one small hospital, the part-time services of a pathologist only involved surgical pathology, including a monthly surgical conference with physicians on the hospital staff. Those in the clinical laboratory had no contact with this pathologist. The part-time services of a pathologist in another small hospital included a much broader range of activity. Besides reviewing the surgical pathology, this pathologist always stopped by the clinical laboratory and discussed current problems with the workers. Possible sources of error were reviewed, suggestions about procedures and use of equipment were made and, when appropriate, instrument calibration was undertaken. From time to time he had the results of specimens from patients in the small hospital double checked by larger hospital laboratories. Finally, he encouraged the workers in their small hospital to call upon the laboratory supervisor in a larger hospital for advice and consultation.

Another alternative to increased medical participation in laboratory services is the local physician. Interviewers found a wide variation in the kinds and degrees of participation other physicians had in the laboratory.

It must be emphasized, however, that no matter how actively and frequently other physicians participated in laboratory activities, all supervisors in laboratories without the services of a pathologist felt that this arrangement was inadequate for good laboratory management.

Some physicians felt responsible for all activities in the laboratory. These men usually made daily visits and answered questions, suggested methods of procedure and, in general, kept the laboratory personnel informed about the particular progress of a patient when laboratory results were involved. Others had little to do with the laboratory or the workers, they only appeared to request a specific test, to question the results of a test or to suggest a test be sent out to a different laboratory. Seldom did these physicians actually become involved in the day-to-day activities of the laboratory.

Again, since it is unlikely that the supply of physicians will increase suddenly, the only alternative of action is the more efficient utilization of present sources of physician participation. Also, if uniform physician participation is to be accomplished, then it would seem reasonable to expect that some existing organization (such as state and national medical societies, working with pathologists and hospital associations) must establish written guidelines to determine the kind and degree of participation for local physicians in laboratory activities.

Interested, knowledgeable and full-time medical supervision of the clinical laboratory in the small hospital is not the only necessary ingredient for more accurate procedures. Each clinical laboratory must be supervised by a technical worker with delegated responsibility. As the results from the twenty-nine interview schedules were analyzed, it soon became apparent that the supervisors in the small hospitals had little voice in the crucial allocation of hospital resources for laboratory operation. Few are delegated an annual budget and most often decisions regarding the purchase of new equipment, hiring of workers, planning for new developments, recommending wage scale changes or other primary management decisions are made by the hospital administrator rather than by the laboratory supervisor.

Frequently in the small hospital, the term "supervisor" only means the senior worker who is responsible for ordering supplies and insuring that laboratory results are reported to the physician at his office or in the hospital, in addition to performing her regular routine procedures. The real isolation of laboratory workers (as seen in Fig. X-XI) from sources of new developments (except for journal articles) is probably most damaging for the supervisor of the small laboratory, for the most part this person is completely responsible for laboratory procedures and results.

Furthermore, the training of the worker is less apt to include principles of management and supervision. Administrators of small hospitals are probably well aware that increased wage scales will attract more highly skilled personnel in most areas, including the position of laboratory supervisor. Few, however, are probably able to evaluate the output of the laboratory and prove the need for more skilled personnel. And, of course, even if the need was established, the supply of highly trained qualified personnel appears to be in short supply. The only apparent solution is the continual upgrading of those now in the position of supervisor and the recommendation that management skills be incorporated in the training courses of those learning to become laboratory workers.

All of these factors are crucial and necessary for the main argument for the alternative of suggesting that small hospitals diagnose and treat most of the cases received. There must be continuous, interested and knowledgeable medical leadership; there must be effective supervision of the laboratory including efficient use of present equipment and the purchase of new equipment when necessary; efficient purchase of supplies, the adoption of procedures known to be correct and the continual upgrading and training of workers.

It is being suggested, therefore, that the accuracy of one particular test by one particular worker in the small hospital is dependent upon all of these factors. Without close and interested medical interaction and without the proper equipment, supplies and method of management, the chances of continually producing accurate and reliable results are seriously limited, regardless of the initial training of the worker.

If all these conditions are met they are, of course, necessary but not sufficient to insure that laboratory results will be quickly and accurately performed. The remaining sufficient condition is the ability and skill of the individual worker.

It must be understood that much of the variation in worker ability in the laboratory is related to the variations found in different procedures. Procedures have been developed that make it relatively easy for almost anyone to determine the amount of sugar in a sample of human urine, for example. On the other hand, the correct identification of certain organisms in the blood or spinal fluid may take weeks or months to determine, requiring special media, incubation techniques, careful microscopic inspection, daily cultures from the same site, sensitivity testing and constant researching of recent literature in addition to sending the cultures out for confirmation.

Again, it is the fact that a rather broad range of patient diagnostic and treatment procedures are carried out in the smaller hospital that makes it necessary for the laboratory to perform both the "routine" type of determinations which require minimum skill and more complete determinations which apparently are frequently inaccurately performed.

Unless the pay scales and general orientation of the administration and boards of directors undergo some sudden and dramatic changes, it is difficult to conceive a situation in which more highly trained workers will choose to work in small community hospitals (with one notable exception, which will be discussed shortly).

Again, as in the case of the supervisory personnel, the sudden demand for more highly trained workers will not increase the immediate supply. Moreover, while the opportunity for advancement is not great in the larger hospitals (and will be discussed there), the opportunity for advanced responsibility in the small hospital is almost non-existent.[15] As long as the only hierarchy in hospitals is related to bed size and there is no real "system" of hospitals and each hospital is an independent unit onto itself, it is difficult to suggest mechanisms of advancement for the worker in the small hospital, especially if that worker is a married female whose living location depends on her husband's place of occupation.

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[15] This is a common complaint of many of those in the paramedical fields and William Stewart, M.D., Surgeon General, has suggested that more opportunities be made available to those in various health occupations for advancement and increased medical responsibility.

If any change in the accuracy of performance of these workers is to take place, the change must start somewhere. Instead of one approach, perhaps several are possible.

If it is assumed that some of the inaccuracies made in procedures in small hospitals is not completely dependent upon skill level of the worker, then more outside checks by health departments and other authorities may increase accuracy. The high percent of accurate results received in serology determinations in this study supports this line of thought. For laboratories to be qualified to perform pre-marital serological tests for syphilis and report results to the physician who, in turn, uses this to issue a form to the couple who applies for a marriage license, laboratory workers must be continually checked on their accuracy. In North Carolina, the laboratory worker must be certified and his or her registration number stamped on the laboratory report which goes to the physician. There is no reason why some other categories of tests could be treated in the same manner in the public interest of better health care.

The continuing education of the current worker stands out as another obvious means to the increase of accurate laboratory results. Not so obvious are available mechanisms for the continuing education of these workers. It is the case, however., that lay boards of education see the necessity of continuing education for teachers and pay scales and promotions are frequently based on such activities. It may be the case that hospitals' lay boards could become interested in worker advancement, particularly if it was understood that the welfare of patient care was directly involved in work performance.

Finally, there is an element in this occupation which emerges from the review of workers and their work. In very plain terms, the laboratory worker, particularly in the small hospital, is not part of a health care "team". In a typical day, the physician requests certain tests to be performed on specimens from his patient. The individual worker seldom, if ever, knows the diagnosis (or even the patient, unless she is the one that collects the specimen) and routinely carries out the procedures of blood count, urine, stool, etc. in a work-a-day fashion.

Compared to the nurse, for example, who has the opportunity to follow the progress of the patient, work directly with the physician and occasionally make suggestions and participate in discussions of the diagnosis and prognosis of the illness, the laboratory worker is almost completely divorced from this medical "interaction", yet his results (as in the case of antibiotic sensitivity tests) are taken as "law" with no questions frequently asked and the patient treated accordingly.

It would seem reasonable to assume that, as the worker becomes more meaningfully involved in the diagnosis and treatment of the patient (particularly in smaller hospitals where the availability of pathology services are so severely limited), they would become more concerned about their own ability, training and performance.

Returning to the second alternative for improving the accuracy of output in the small hospital laboratory, it was suggested that the range of laboratory tests be restricted to include only those procedures which may be performed by workers with less sophisticated skills and no advanced training.

There are an array of problems connected to this suggestion, most of which directly involve the current practice of medicine in small community hospitals. Any limitation or restriction on the range of tests in a hospital laboratory is an automatic limitation on the kinds of medical procedures performed on the patient in that hospital or, more briefly, a limitation on the practice of medicine.

At this point in time, controls on the practice of medicine by licensed practitioners can only be termed voluntary (with some exceptions; for example, abortion and sterilization procedures). Thus, a restriction on tests performed would strike at the very roots of medical practice in this country and, therefore cannot be suggested as a quick method to solve the current problem.

Technological advances in the transport of patient specimens and the wider use of automated equipment may some day mean that all laboratory testing may be conducted away from the hospital, but today these developments are only on the horizon.

Conclusion

Assuming that those responsible for the small community hospital laboratories wish to improve output and highly skilled workers will be unavailable, then hospitals should:

(a) have a consistent and effective arrangement for medical supervision of the laboratory,

(b) take action to insure that workers are continually trained by attending meetings, conferences and enrolling in refresher courses,

(c) work with the medical staff to increase the involvement of the worker with the care of the patient,

(d) allow and encourage the supervisor to participate in management decisions of laboratory affairs,

(e) welcome and encourage various methods to check laboratory results in other hospitals or health department laboratories,

(f) encourage the establishment of MT(ASCP) approved correspondence courses for updating knowledge and techniques.

Smaller hospitals seldom have the individual personnel nor resources to institute broad programs of change or improvement. Therefore, it is further recommended that small hospitals work together on these problems through the various existing groups now concerned with medical care in the smaller hospital. These include the pathologists, the county medical societies, the hospital administrator and the laboratory supervisors.

The Worker in the Medium Sized Hospital

Results from this investigation have determined that there is more variation in the overall quality of output in medium sized hospital laboratories than in either large or small hospitals studied. The ranking system derived from the findings of this study rated all large hospitals high in quality of laboratory output; all small hospitals low and medium sized hospitals equally divided between medium and low quality.

The problem of low quality output in small hospitals may be solved by the application of new developments in automation and the establishment of regionalized laboratories. These same developments, however, probably will not radically change medium sized hospital laboratory activities for some time to come, especially in those medium sized hospitals staffed with full-time pathologists and equipped with expensive automated testing devices. In spite of technological developments, therefore, the manpower requirements for the medium sized hospital laboratory may well remain constant or even increase in the next ten years.

Looking more closely at the manpower characteristics of the medium sized hospital laboratories in the sample indicates that these hospitals are the meeting ground of the advanced trained and the more quickly trained worker (the MT[ASCP] worker and the commercial school graduate as well as the on-the-job trained worker). It would appear that only under special circumstances those in small hospitals are able to attract or willing to pay workers with advanced training. Conversely, those responsible for the laboratory procedures in large hospitals are apparently reluctant to hire the commercial school graduate. Thus, the medium sized hospital is a unique meeting ground for these two groups.

During the field investigation, it was observed that quickly trained workers worked side-by-side with those with advanced training. It also appeared to be the case that those with advanced training were able to train commercial school graduates on a day-by-day basis.

Analysis of the data indicated, however, that the six hospitals rated medium in quality had a higher percent of workers with advanced training than the six hospitals rated low in laboratory quality. It was the distinct impression of the investigators that this difference in quality was more dependent upon the supervisor and pathologists medically responsible for the laboratory than upon the prior training of the worker per se. The impression emerged during the field investigation and the subsequent analysis of the material was this:

Under certain supervisory situations, workers with different degrees of training work together effectively and produce accurate and reliable results; in other situations in which supervisory direction was weak or pathological coverage was ineffective, any mixture of workers with varying degrees of ability always produced lower quality output.

The indication that the "mixture" of workers (under correct supervision with continuing on-the-job training) is effective suggests that larger hospitals could gradually fill severe manpower deficiencies by employing quickly trained (or untrained) workers and bringing them up to a higher standard of performance through on-the-job training.

In four of the six hospitals rated "medium" (as opposed to the remaining six rated "low"), it was the case that full-time pathologists were interested in the clinical aspects of laboratory work. Here the pathologist was interested in and aware of late advancements of instrumentation and techniques. Moreover, he worked closely with the supervisor so that consistent personnel policies of hiring, promotion and salaries were maintained.

By contrast, two of the six hospitals rated "medium" by the standards developed for this study were, in fact, characterized by dissatisfaction among workers. It was the distinct impression of the field investigators that, in these laboratories, the pathologist was not involved actively in employee activities, practiced irregular hiring policies and generally isolated himself from the daily activities of the laboratory and the workers unless, of course, a mistake was made or some other problem occurred.

Employee morale in these two laboratories appeared to be low; workers complained about the routine nature of their jobs, the lack of involvement in general laboratory activities and infrequent opportunities for advancement or increased responsibility.

Employee complaints and general dissatisfaction, low morale and inconsistent personnel standards appeared more frequently in the medium sized hospitals generally rated low in the study.

Again, however, two exceptions were found. In one hospital, the administrator had become interested in and knowledgeable about laboratory procedures and methods. His interest in the laboratory and apparent confidence in the ability of the supervisor had led to the purchase of new equipment and generally had added to the spirit and enthusiasm of the employees.

Although "hard" measures developed for this study rated this hospital "low", it was the impression of the field investigator that the continual interest of a knowledgeable administrator would mean eventually a higher quality output for this laboratory.

country designed to train laboratory workers for supervisory positions. Variations in the qualifications of supervisors were apparent as the background of the supervisory personnel were compared. The most consistent qualification appeared to be years of service, followed by education and training.

However, nowhere was the isolation of the supervisor more striking than in some medium sized hospitals with full-time pathologists. By all standards of training, experience and job tenure, certain supervisors were highly qualified for their position but were "disfranchised" from their supervisory role.

Anyone who has examined the organizational structure of the health professions, particularly hospital organizations, soon becomes aware of the hiatus between physicians and other health workers. The isolation of certain laboratory supervisors in the general management decisions of some laboratories must be a classic example of this cleavage. The mechanism which was found to effectively curtail supervisory involvement was the denial of a management "workbench" - an equipped office with privacy.

As indicated, those supervisors who had the authority and the mechanism to manage laboratory affairs frequently initiated an order for new equipment for processing laboratory results. In the past, the purchase of highly technical, sophisticated equipment involved local or nearby dealers and very often setting up the equipment, calibration and repairs required working with repairmen or salesmen not always highly skilled or immediately available.

Many equipment companies have discontinued their relations with local agencies and now directly service their own equipment. To better serve their customers, these same companies invite direct, collect telephone calls to their service departments (on a twenty-four hour basis) and assist employees in the adjustment of machinery and equipment on an immediate basis. If the necessary adjustments cannot be made in this manner, the company places a service man on the next available flight to the local area.

This development in service is important, for it means that highly automated equipment can keep functioning (many newer models frequently require adjustment) and patient specimens processed.

As automated equipment increases the work capabilities of current employees, fast servicing is a necessary requirement. Of course, without the equipment, the work force cannot keep pace with demand on a "manual" basis. Finally, many companies now offer free, two-week training courses for laboratory workers when they sell and install devices such as automatic chemical analyzers.

That which has been termed "General Operations", including methods of laboratory procedure, record keeping, instrument calibration and use of equipment, varied noticeably as the medium sized hospitals were compared. Here again the variation was more closely associated with variations in supervisory personnel than in worker variation as such.

In several medium sized hospitals rated low, outdated, unreliable and inaccurate methods were observed. To the field investigators, it was apparent that supervisory personnel responsible for the selection of methods and equipment were isolated not only from the pathologists but also the technical advancements and improvements in their own field.

Rapid changes and development of new techniques in a field as this one, of course, necessitates continual upgrading of techniques. When this is not taking place, those who remain with previously established methods are automatically proceeding in an inaccurate or substandard way.

The average laboratory worker, it appeared, was not generally in a position to suggest new methods that call for the reorganization of procedures or the purchase of new, expensive equipment. Few workers complained about the technological "lag" of their laboratory. Few of those quickly trained and, of course, none of the on-the-job trained were up-to-date on technical improvements and able to suggest modification of techniques.

Questionnaire results indicated that workers in medium sized and small hospitals had little chance for "occupational" interaction; that is, the opportunity to move from hospital to hospital to observe new techniques and developments, attend training courses or commercial demonstrations of new equipment.

Conclusions

Variations in the quality of output in medium sized hospital laboratories must be viewed as unnecessary and undesirable. Without question, it is important for each patient to receive uniform, high quality and accurate laboratory services regardless of the health facility involved in his care.

The results of this study suggest that variations in quality of laboratory performance are more dependent upon the nature of laboratory supervision than on the training or experience of the worker, as such. Thus, the recommendations for the medium sized hospital laboratory are similar to those put forward for the small hospital; namely, consistent and effective medical supervision in the laboratory (including a strong interest in clinical pathology on the part of full-time pathologists), continued training of workers, increased involvement of workers with the care of the patient and the institution of methods to check upon laboratory resutls.

It is further recommended that each laboratory supervisor be given the management authority to truly supervise the laboratory. Along with this authority, it is vitally necessary to provide adequate, private working space and equipment to carry out management responsibilities.

Variations in methods of procedure and the failure on the part of some supervisors to adopt to commonly known new methods suggests the need for a management or supervisory training course. One kind of continuing education course is needed immediately for those in the field and other courses should be provided in the training courses for workers certified by the American Society of Clinical Pathologists.

It was observed that the medium sized hospital setting is one in which both advanced trained and quickly trained workers work side-by-side in apparent harmony and, in some cases, fairly effectively. Furthermore, workers with advanced training can be called upon, it appears, to train others on-the-job in techniques and methods necessary for reliable and accurate performance.

Thus, some of those responsible for medium sized hospital laboratories have found a method to utilize workers with different degrees of training and ability; workers, by the way, which more closely match the available supply. Considering the fact that many laboratory procedures can be performed by those with less advanced training, this distribution of workers also more closely matches the requirements of present day laboratory needs.

The Worker in the Large Hospital

In the previous section, it was determined that the three larger hospitals (300 or more beds) in the sample ranked highest on all the rating scales constructed from the findings. More specifically, all clinical laboratories in these hospitals are characterized by the following attributes.

1. All have and use the latest automated equipment available.

2. General methods of operations were consistently of high quality in each. Procedures used in making laboratory tests are those usually regarded as most accurate. In addition, "emergency" alternate, manual procedures have been developed which can be used if automatic equipment breaks down or needs adjustment.

   Log books are maintained in each department of the laboratory making patient information available to physicians at a later date. In addition, a duplicate copy of the report of the patient's test is always held on file in the laboratory.

   In each hospital, only the pathologist or the supervisor is responsible for the calibration of laboratory instruments. Only proper and suitable equipment is used for each specific laboratory test. For example, when solutions must be accurately measured, only tested and precalibrated instruments (pipets) are used. Each of these instruments meet standards established by the National Bureau of Standards or, if other less expensive measuring devices are used, these are calibrated by the aforementioned instruments before use.

3. All laboratories in the larger hospitals are supervised by registered medical technologists certified by the American Society of Clinical Pathologists, all have a bachelor of science degree and each has had at least 10 years experience in their present position.

4. Each of these laboratories has the full-time services of three or more pathologists.

5. Combined test scores on the results of the unknowns sent out during the study period were highest in this group.

6. Fig. XIII illustrates the high percent of registered medical technologists certified by the American Society of Clinical Pathologists.

7. Within each laboratory, standards and controls are used at least daily. On certain types of automated equipment, the results of controls are posted providing a visual record of the variations in the equipment. The results of these controls can be readily and easily compared to the results of patients' tests.

In a sense, the larger hospital clinical laboratory can be viewed as a "control group" in this study, particularly in regard to methods of procedure and quality of output. Furthermore, in the large hospital, the frontier of automated procedures and new techniques is being pushed forward on a day-to-day basis. For example, use of the 12 channel automatic chemical analyzer quickly and accurately provides the physician with 12 different results of chemical analysis of the patient. Not only is it possible to more effectively diagnosis suspected diseases with this kind of knowledge, but also unsuspected disease may be discovered. Moreover, this technique streamlines laboratory operations since it often removes the need for repeated requisitions with multiple handling of specimens, reports and charge tickets.

Further developments in automatic record keeping soon will make it feasible to conduct large scale epidemiological studies of these results, data that is often useful in developing new methods of disease prevention and control.

Finally, the quick retrieval characteristics of patient information promises to facilitate the continuity of medical care. Frequently it is time consuming, difficult and costly for the physician to review the case histories of patients, particularly if the patient has received care in another hospital and/or another area. Electronic retrieval methods would allow easy access to past medical conditions, complete with previous laboratory testing results. Obviously, then, the results of past testing could be compared with current diagnostic tests - a must for continuous surveillance of some chronic conditions.

Although manpower requirements associated with these developments are the concern of many in the health field, it is difficult to accurately predict needs. It does appear, however, that the need for highly trained workers in large, automated laboratories may be reduced.

It was almost paradoxical to discover that proportion of highly trained workers was higher in the three large hospitals surveyed. Naturally the existence of training schools in these hospitals, the larger budgeted amounts for personnel and the presence of full-time pathologists in these laboratories all account for the higher proportion of workers certified by the American Society of Clinical Pathologists.

In terms of need, however, the results of this study indicate that more highly trained workers are required in medium sized and small hospitals, particularly for supervisory personnel. Thus, it is recommended that larger hospitals could review their current requirements for personnel with the thought that larger hospital laboratories could both train and place workers in other "regional" hospital laboratories. Not only would this step increase the distribution of qualified personnel to various hospitals throughout a given area of a state, but also it would establish a positive and continuous "link" between hospitals and laboratory services.

Once an effective network of workers is established, hospital laboratory workers could share developments in techniques, check questionable results, establish routine checking methods and generally establish a "pool" of procedures and advancement in procedures beneficial to all.

Study results also indicated that many advanced trained workers (under and over 30 years of age, married and never married) were planning to leave the occupation. Reasons vary, but perhaps the underlying dissatisfaction with this career lies in the lack of opportunities for advancement and increased responsibilities. It would seem that a training and placement program would encourage more workers to remain in this occupation especially if their duties, responsibility and salary more closely matched their training.

INTERPRETATION OF FINDINGS

Although the body of this report is properly limited to the factual documentation of the methodology and findings of this study, the intent of the Department of Labor in supporting it was, of course, more pragmatic. The Department not only wished to contribute to the health literature, but also was obligated to attempt to isolate nation-wide problems and to search for concrete suggestions for their potential solution. Accordingly, this section is designed to interpret rather than to report, to synthesize solutions rather than to summarize findings and to extend the discussion beyond the limited borders of the research project.

Although disappointing, it was not surprising that this research revealed that, at least in the sample studied, the standard of performance in all laboratories was not of uniform high quality. This has been suspected, but never before proven on a state-wide basis on such a complete spectrum of clinical pathology and by using such hard indicators of quality as the testing of unknown samples. The conclusion, therefore, must be drawn that, in certain cases, neither the physician nor his patient were being adequately and accurately served. It could be interpreted to mean that some patients were erroneously diagnosed or inappropriately treated. It could also be interpreted that the patient or his agent was charged for things which he not only did not get, but which actually may have done him harm - the complete antipathy to the purpose of hospitals or the wish of physicians.

The problems of the small hospital are complex and, at least to the informed, generate nothing but admiration and sympathy. As a nation, we have created small hospitals. We have demanded essential full-service health care centers close to our homes yet we have avoided facing the fact that economically this is not possible without either exorbitant costs or limitations in service and quality. This study not only revealed poor quality in most small and in half of the medium sized hospitals, but it also indicated that the technicians in such circumstances were usually lower paid and possessed less formal training than those ranking higher on the quality scale. But one could very well argue that it is not the lack of funds but rather the lack of availability of qualified candidates willing to work in small hospitals that causes this unfortunate circumstance.

In either case, what corrective measure might be considered? Certainly, the study indicates that effective and attentive supervision of the laboratory, particularly by a clinical pathologist, has a salutary effect on the quality of the work performed. If such supervision was universally available perhaps, therefore, high quality could also be universally available. This prospect challenges not only the pathologists but also hospitals, their technicians and the whole organization of laboratory services.

An increase in the number of pathologists to any fixed population sample should theoretically increase the amount of available supervision and, therefore, increase the quality of laboratory results. However, it is not this simple. As of 1965, the American Board of Pathologists had certified only 6,709 individuals and some 40% of the pathology residencies remained unfilled. "This pool of talent is not certain to be sufficiently large to meet the United States' growing medical manpower needs."[16]

The problem of supervision in the small hospital, therefore, remains. The maldistribution of pathologists is difficult to overcome - travel time, lack of professional stimulation and inadequate social satisfaction all work against equitable distribution. Whereas, in some professions the relative supply of manpower can be increased through more efficient use of the physician's time, it appears that little such gain can be expected in the field of pathology since most pathologists have already turned over all but the discretionary matters requiring true medical judgment to technicians and aides. Therefore, at least in the clinical pathology aspects of laboratory work, most pathologists already serve in a supervisory role and no greater supervisory effort could probably be achieved.

The availability of physicians trained as internists with a special interest in the clinical laboratory is even less promising. However, the variety of ways and the degrees of diligence which pathologists exercise this supervision, particularly in part-time situations, suggests a possibility that some manual or guidelines could be developed nationally by organized pathology much as the College of Pharmacy of the University of Michigan produced in 1958 for part-time pharmacists in small hospitals. This text, if adopted and applied to laboratories in small and many medium sized hospitals, could bring to these professionally isolated laboratories the quality of supervision which should, in turn, produce a higher level of laboratory performance with the same personnel and with minimal added costs. Heeding the five points listed in the conclusion of the section on "The Worker in the Small Hospital" would be added assurance.

One would like to assign to the technologist a more comprehensive role in upgrading laboratories but the realities of the situation prevent this. As in other professions and in many trades, the worker dedicated to quality and high standards can organize and police many of their own membership but, particularly when demand outstrips supply, they cannot police or control the mass of workers who, with less training or experience, invade and inudate the field. If the public interest is not ultimately served, outside control is superimposed usually by government through licensing, registration or other limiting measures. To date, such controls in medical technology have been injected very sparingly; in fact, by only one state.

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[16] Survey of American Pathologist, reprinted from Laboratory Investigator, Vol. 14, No. 12, Williams and Wilkins Co., Baltimore, 1966, pg. 6.

The fact that laboratory technology is evolving so rapidly, with an ever expanding spectrum of methods and procedures, works against the easy establishment of any such control system. Therefore by default, technologists, hospitals and their own medical staffs must continue or begin, as the case may be, to exert on an individual institution basis the maintenance of high standards. The Joint Commission on Accreditation of Hospitals in the area of Blood Banking and Health Departments in the area of serology have exerted some pressures for quality and this is perhaps why performance in such areas is so consistently above average. A little more of this type of evaluation should be encouraged by those groups by hospital associations and by other educationally, not punitively, oriented organizations.

The greatest area of potential gain in the upgrading of laboratory quality seems to reside in a revision of the organization of laboratory service. As the findings show, some 87% of all laboratory tests performed, specifically those classified as hematology, urinalysis or chemistry, can be automated to a major degree. Yet, automation is expensive and requires volume. Therefore, the goal of quality could still be elusive if volume remains small. Certainly, the volume of most small hospitals is below the minimum considered reasonable for automation. However, except for a few remote areas of our country, most small hospitals are within 30 to 60 minutes of a larger institution which often serves in one or more ways as a regional center. The addition of a regional laboratory is not only obvious, but experience has shown it to be successful.

The still popular but perverted definition of free enterprise and self-determination cloud the over-riding potential of gaining quality at lower cost. To be sure, minimal services will have to remain on-premises for the very simple and routine procedures and for a limited but manageable list of emergency procedures if the distance proves to be a real deterrent, but a study of each situation should result in a solution satisfactory to each institution. In general, this research shows that such work can be adequately performed by most individuals serving as laboratory technicians today.

A corollary to this, of course, is to have the medical staffs agree on what kind of patients should and should not be admitted to hospitals whose laboratories can't accurately and completely meet the needs of the patient. One can question the propriety of admitting a patient to an institution knowing that the full range of diagnostic procedures appropriate to his illness cannot be adequately obtained. In this way the admitting practices of physicians themselves could upgrade the quality of laboratory performance by restricting the demand for procedures requiring high competence.

The clinical laboratory is a keystone in modern medical practice. Anything less than high quality performance directly undermines the very foundation of quality patient care. No one can accept less than the best.

METHOD OF GRADING RESULTS OF UNKNOWNS

Introduction

Anyone who takes a school course in chemistry, biology or physics soon becomes familiar with one rule of "exact" science - observational and experimental results are either accurate or inaccurate. From this experience it may be natural to assume that the results of clinical hospital laboratory tests are always accurate or inaccurate and no middle ground is tolerated or accepted. One may be especially compelled to feel this way when it is known that the results of clinical tests almost always help to determine the course of individual medical treatment and can have a direct affect upon the recovery of hospital patients. Yet after carefully considering the present laboratory situation in North Carolina and the Nation and after a detailed review of all the results of the unknowns sent to hospitals in the study, a grading system of "accurate" and "inaccurate" was expanded for this study. The investigators used a more sensitive ranking which includes "minimal" along with "accurate" and "inaccurate".[17] With this range, the methods and results of this study can be meaningfully used by others to improve and upgrade clinical laboratory procedures.

The grade of "minimal" is defined here as operationally acceptable. That is, results graded minimal will grossly suffice for the particular laboratory determination area tested but the grade does not meet the standard of accuracy known to exist today.

The grade "minimal", therefore, was carefully constructed to reflect a quality of procedure which will provide the medical practitioner with substantive knowledge to assist in the diagnosis and treatment of patients.[18] While the detailed method for establishing the minimal range appears below, considerations used to arrive at this score in chemistry may serve as an example. In chemistry, minimal performance on the unknowns probably reflects a certain kind of laboratory situation in which, for example, instrument calibration may be incorrect. The degree of inaccuracy, however, is within a range that would lead one to assume that results from this laboratory are comparable with one another, consistent and not highly skewed.

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[17] Of course, the establishment of a "normative" standard for the rating of procedures (one based upon the researchers working with consultants, in this case) is a familiar technique in health evaluation research. For a full discussion, see Donabedian, Avedis, M.D., "Evaluating the Quality of Medical Care", Milbank Memorial Fund Quarterly, July 1966, Vol. XLIV, pp. 166-206.

[18] By the construction and use of the "minimal" grade, the investigators do not intend or imply to endorse its acceptance by the medical profession as an acceptable standard of performance.

Charged with the responsibility of offering concrete and realistic recommendations to those concerned about the manpower requirements of the laboratory field, the authors assert that the standard of minimal performance is a standard which all hospitals in North Carolina, and probably in the Nation, could attain and sustain in the immediate future, while the goal for complete accuracy is being achieved through better training, better supervision and better health care organizations.

Of course, the study results indicate that even this intermediate goal is far from reached today especially in bacteriology and chemistry. Conversely, the authors feel that any present day attempt to enforce an immediate standard or to insist upon a "crash" program that would insure complete scientific accuracy of all results in all hospitals is unrealistic when the inordinate demands for laboratory services are considered along with the limited supply of manpower, equipment and current organization of most hospitals' clinical laboratories.

The one official group charged with the responsibility of insuring quality medical care in American hospitals today, the Joint Commission on Hospital Accreditation, has had to employ minimal standards for hospitals in general and laboratories in particular. Speaking to the laboratory area, the Commission requires "....that a urinalysis and either a hemoglobin test or hematocrit examination be done on all patients admitted. These are minimal requirements and in many instances should be exceeded."[19] Furthermore, the Commission does not insist that laboratories employ technologists, registered by the American Society of Clinical Pathologists, even if the laboratory has no pathologist, but only suggests this hiring policy is a "....factor in evaluating the quality of laboratory services".

Actually, the Commission avoids the entire question of accuracy of clinical results when it notes, "Besides supervision and competence of personnel, the hospital laboratory is evaluated on the basis of the adequacy, speed and completeness of its laboratory service." Certainly the Commission is aware of shortcomings in laboratory results and the necessity of accurate procedures and reporting as it issues this warning to hospitals in its final statement on laboratories.

> Attention should be called to the necessity for checking the calibration of special laboratory instruments and equipment regularly and periodically. Faulty thermometers and inaccurate colorimeters have been reported in several instances in hospitals. Further checking showed they had not been checked since placed in service.

Given sufficient personnel, funds and time anyone familiar with laboratory procedures knows that the Joint Commission on Hospital Accreditation could improve the accuracy of clinical results in hospitals if the following basic measures were enforced: in the absence of a full-time pathologist clinical laboratories had to have supervisors registered by the American Society of Clinical Pathologists; log books be kept and inspected on the calibration of equipment (and that the calibration be carried out by authorized individuals); unknowns be sent to hospitals on an unannounced schedule (results sent back by return mail) and the accreditation of the laboratory (as well as the hospital) be determined by the accuracy of the results. This latter procedure is now carried out by State Health Departments in serology and blood bank which well may account for the higher accuracy of study results which were received for these two areas. In other words, the present accreditation procedures for hospital clinical laboratories can only be rated as "minimal" by any known standards and especially by the standards of natural science upon which most of the clinical tests are based.

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[19] Explanatory Supplement to the Standards for Hospital Accreditation: Joint Commission on Accreditation of Hospitals, Chicago, Ill., 1960.

Finally, it must be recalled that loss of or lack of accreditation does not close down any hospital or in any way discontinue its operation as an institution.

Therefore, it is one of the recommendations of this study that the Joint Commission on Hospital Accreditation establish a method whereby quality standrds of laboratory results can be reviewed by the Commission. Further, it is recommended that the quality of these results have a bearing upon the accreditation of the hospital.

Method of Grading

Bacteriology

Among the almost limitless number of organisms that could have been selected for unknowns in bacteriology, the selection was limited to throat, urine, stool and wound cultures. It is the organisms from these sources that both the physician and technologist most frequently look for and isolate, in both the smaller and larger hospital, in the routine diagnosis of disease. In addition to, and often times in substitution for, cultures, smaller hospitals must rely upon the results of Gram stains to supply the physician for an immediate course of treatment. For this reason, Gram stains were included in the unknowns as well as cultures.

Stock cultures (organisms) were secured from the American Type Culture Association and screened to insure that typical cultures were used in the unknowns. A pre-tested mixture of two or more organisms was placed in screw-cap vials of transport media. All but the control cultures were inoculated just prior to shipment and the control cultures were allowed to stand at room temperature 48 hours so that control conditions matched field conditions. Gram stains were prepared in the usual manner.

APPENDIX A

Each technologist tested in bacteriology received one set of throat, urine, stool and wound cultures and two Gram stains. Three different sets of throat and wound cultures, containing two organisms, and four different sets of urine and stool cultures, containing two or three organisms, were used in all. Each tube was labelled "throat", "urine", etc., so that the appropriate media would be selected for use. On the other hand, a pre-coding method was used in selecting tubes for packaging and no other markings appeared on the tubes to alert technologists that they had similar or different cultures than their working companions. The following cultures were combined to make each set.

Throat Cultures

beta hemolytic streptococci
hemolytic staphylococci (coagulase negative)
hemolytic staphylococci (coagulase negative)
non-hemolytic staphylococci (coagulase positive)

Urine Cultures

Escherichia coli
Aerobacter aerogenes
enterococci (group D streptococci)
hemolytic staphylococci (coagulase negative)
hemolytic staphylococci (coagulase positive)
Proteus sp. (non-spreader)
Pseudomonas aeruginosa
diphtheroids

Stool Cultures

Escherchia coli
Aerobacter aerogenes
Salmonella sp.
Shigella sp.
Proteus sp. (non-spreader)
Pseudomonas aeruginosa

Wound Cultures

Proteus sp. (spreader)
hemolytic staphylococci (coagulase negative)
hemolytic staphylococci (coagulase positive)
Pseudomonas aeruginosa
Clostridium sp.

APPENDIX A

Three different sets of Gram stains were used. Each slide contained either one or two organisms. The following organisms were used.

Gram Stains

Gram negative diplococci
Gram positive cocci
Gram negative bacilli
Gram positive bacilli

The results from the bacteriology unknowns were graded as follows:

Cultures

Accurate: Complete identification of all organisms present.

Minimal: Identification of only one of the two or more organisms present. Partial, but incomplete, description and identification of only one organism present and/or the listing of the name of an entirely different organism, not included in the mixture.

Inaccurate: Unable to identify any organisms present.

Gram Stains

Accurate: Complete and detailed description of organism or organisms present, listing Gram reaction.

Minimal: Description of only one organism present when two organisms were used or, where one organism was used, partial description of this organism. Partial description of organism or organisms present or reporting the name of an organism instead of describing its Gram reaction.

Inaccurate: Failure to report Gram reaction on any organism present.

Several complete sets of randomly selected unknowns were sent to North Carolina Memorial Hospital and the North Carolina State Board of Health. Their reported, written results exactly coincided with the pre-selected organisms and are in the files of the study.

APPENDIX A

Blood Bank

Blood Bank specimens were blood samples drawn from normal healthy individuals in donor sets containing ACD Solution. Blood was drawn approximately two days prior to shipment. Each technologist performed two tests in this area, blood group and RH factor. Blood was collected and shipped under sterile conditions. The Blood Bank at the North Carolina Memorial Hospital tested randomly selected samples of the unknowns and submitted a written report of their tests. Results were graded in the same three classifications:

Accurate:	Both unknowns correct.
Minimal:	Only one correct.
Inaccurate:	Both incorrect.

Chemistry

All chemistry unknowns were lyophylyzed, (dried) serum samples supplied by commercial companies. Various water reconstitution values were used so that technologists reported different results on the same type of unknown. Technologists received different values ranging from low to high. Again, unknowns were selected in such a way that technologists were not able to identify similarities or differences in values received.

Technologists received the following chemistry unknowns commonly performed in most clinical laboratories: sodium, patassium, chloride, glucose, urea nitrogen, bilirubin and amylase. Control values listed by the commercial suppliers were carefully and extensively checked and established by the Clinical Chemistry Laboratory of North Carolina Memorial Hospital. Based upon statistical, clinical and medical experience, ranges were established to measure the variations of reported results from the known values and results were graded accurate, minimal and inaccurate.

Hematology

Blood samples used to prepare smears for the description of both white and red blood cells were donated by normal patients, patients with diagnosed infectious mononucleosis and from patients with numerous types of anemias. All smears were prepared, stained and individually and carefully screened by the Hematology Laboratory at the North Carolina Memorial Hospital. Each technologist tested in hematology received two stained smears. Each person was instructed to perform both a differential white blood cell count and describe the red cells.

APPENDIX A

Two types of hemoglobin specimens were used:

1. Hemoglobin samples previously diluted with Drabkin's reagent and sealed in amber colored glass ampules.
2. Whole blood hemoglobin standards - diluted by the technologists.

North Carolina Memorial Hospital, Ortho Diagnostics and Hyland Laboratories served as control groups for this phase of the study.

Blood smears were graded as follows:

Accurate:	Proper identification, including naming the stage of development of the white blood cells; accurate description of the red blood cells.
Minimal:	Partial identification of the white blood cells; partial description of the red blood cells.
Inaccurate:	No report of any abnormal white cells; either did not comment on red cells or listed an incorrect response.

Hemoglobins were graded as follows:

Accurate:	+ or - 3% of a figure which coincided with both the control groups and the commercial suppliers.
Minimal:	Any result greater than 3% and less than 10%.
Inaccurate:	Any result 10% or greater.

Parasitology

Parasitology unknowns were prepared from clinical specimens and formalin preserved in sealed vials. Unknowns ranged from negative to one, two or three unknowns (Protozoa and/or Helminths). Each technologist performing parasitology unknowns received two vials. Control groups were the School of Public Health, University of North Carolina and the North Carolina State Board of Health, Raleigh, North Carolina.

Results from parasitology unknowns were graded as follows:

Accurate:	Correct identification of all ova and parasites present.
Minimal:	Correct identification of some, but not all, ova and/or parasites.
Inaccurate:	Incorrect identification of all ova and parasites from both unknowns.

Serology

Blood for serum used in the serology unknowns was drawn from persons with a known positive serological test for syphilis. Some known negative donors were also used. Fresh blood was drawn under sterile conditions, the serum separated and frozen approximately one week prior to use and 0.1 ml. of 1% merthiolate was added to each specimen as a preservative. Each technologist performing unknowns in this area received two specimens. North Carolina Memorial Hospital and the North Carolina State Board of Health were control groups for serology unknowns.

Serology results were graded in the following manner:

Accurate:	Results correct from both unknowns.
Minimal:	Results correct from only one unknown.
Inaccurate:	No correct results received.

Packaging and Coding of Unknowns

Preparing, obtaining, coding, assembling and packaging the unknowns called for the imagination, skill, patience and logistic ability of everyone associated with the project. In order to absolutely insure that each technologist worked upon the unknown assigned to him, each vial, tube, slide, container and reporting form carried an assigned code number (T#000). Of course, this meant that each item had to be marked by hand in most cases. Altogether, over 3,000 items were involved in the coding procedures alone. All but the slides were refrigerated before packing (cultures were inoculated just prior to packaging) and packaging took place (149 boxes) on one day. All boxes were refrigerated overnight and were sent the next morning to the hospitals by first-class mail.

APPENDIX B

CRITERIA FOR RATING THE LABORATORY

The following criteria were established and used to rate individual areas of each hospital clinical laboratory in the study. Each rating is a "composite" of several procedures and practices. Laboratories were rated after all aspects of their practices and procedures were considered. Thus, a particular laboratory may or may not match each item in the criteria; however, when an overwhelming number of items fell in one category, such as excellent, then that area of the laboratory received an excellent rating.

BACTERIOLOGY

Poor

Few stains (usually Gram's stain) are performed and then only when requested. Frequently, even though stains are requested, they are not performed.

Usually one, but occasionally two or three, basic media are used for routine cultures regardless of the source of specimen.

In most cases, organisms are neither identified nor isolated in pure culture before performing sensitivities. Only the more common organisms are usually identified, such as staphylococci, streptococci, Escherichia Coli, Proteus species and Pseudomonas. Sensitivity discs usually are placed on the original plate at the same time culture is set up, and no attempt is made to identify nor isolate these organisms in pure culture. Usually more than 10-15 sensitivity discs are placed on one standard size blood plate.

Rarely able to identify and report Gram negative intracellular diplococci from vaginal, cervical and related smears.

Little or no T. B. or fungi work is performed in the laboratory. Almost all cultures are sent to the State Board of Health for identification.

Different types of determinations usually performed:

18-25	different types of routine cultures and smears
1-4	different fungi cultures and smears
1-5	different T. B. cultures and smears

APPENDIX B

Average

Direct stains (usually Gram's stain) may or may not be made from original specimens.

Three basic media are usually used for all routine cultures: these include Blood agar, Eosin methylene blue, Desoxycholate or equivalent and one broth, Thioglycollate and/or an Infusion Broth.

A larger variety of media is used to identify organisms in laboratories in this category than in the "poor" category.

Attempts are made to isolate in pure culture common organisms found in clinical laboratories and most common ones are identified.

Colony counts on urine specimens are usually performed by use of the loop method.

Sensitivity tests are performed on organisms from both pure and mixed bacterial cultures. 6-15 sensitivity discs usually placed on one standard size blood plate.

Attempts to isolate the more fastidious organisms related to Diphtheria, Salmonella and Shigella, but these organisms are not usually identified. Such cultures are referred to the State Board of Health or a larger hospital for final identification or confirmation.

Able to accurately stain and identify Gram negative intracellular diplococci from cervical and vaginal smears. Some attempts are made to culture for Neisseria gonorrhea and Neisseria meningococcus, using chocolate agar in the presence of 10% CO_2. However, these organisms are seldom isolated and correctly identified.

Laboratories in this category perform a coagulase test on all cultures of Hemolytic Staphylococci.

Usually 1-2 media are used for both fungi and T. B. cultures and most common stains are identified.

Different types of determinations usually performed:

40-43 different types of routine cultures and smears
10-14 different fungi cultures and smears
4-6 different T. B. cultures and smears

Excellent

A Gram stain (as well as other types) is performed on most original specimens.

A minimum of 3-5 types of basic media are inoculated for the identification of routine organisms.

A much broader range of media is used in this category for fastidious organisms and for sub-culturing, isolating and identifying such organisms.

Colony counts are routinely performed on all urine cultures.

Sensitivity tests are almost always performed from pure cultures and not more than 6-10 sensitivity discs are placed on one standard size blood plate.

Able to accurately stain and identify Gram negative intracellular diplococci from cervical and vaginal smears. Able to isolate and identify organisms from these sources correctly.

Two or more basic media are used for the inoculation of T. B. and fungi cultures and a minimum of one smear (usually more) is made from the original specimen and, in the case of T. B., several smears are made from the concentrate.

Different types of determinations usually performed:

45-65 different types of routine cultures and smears
10-23 different fungi cultures and smears
10-14 different T. B. cultures and smears

BLOOD BANK

Poor

Two routine preliminary tests are performed on all blood specimens received from donors for transfusions. These are ABO Blood Grouping and RH Typing. The three tube, broad spectrum compatibility test composed of the Protein, Thermo and Anti-globulin phase is used for all Cross-Matches. For Blood Grouping and RH Typing, most use the slide method and seldom any attempt is made to screen for atypical antibodies prior to the Cross-Match.

Average

In addition to Blood Grouping and RH Typing, reverse grouping is usually performed on donor specimens for transfusions. A limited number of tests for screening atypical antibodies are performed. The same methods for Cross-Matching are used as in the "poor" category.

Excellent

In addition to the above, a variety of highly specialized tests are performed to detect, identify and titrate numerous antibodies. Direct Coombs' tests are performed.

APPENDIX B

CHEMISTRY

Poor

Can perform some, but not all, of the following chemistries.

Blood Sugar, Blood Urea Nitrogen, Na, K, CO_2, Chloride, Calcium, Total Protein, Bilirubin, PSP

Different types of determinations usually performed:

10-16	Routine
0-4	Enzymes
0	Endocrinology
0-2	Toxicology

Average

Can perform almost all routine chemistry tests and, in addition, at least two of the following tests for Enzymes: Amylase, acid and/or alkaline phosphatase, SGOT and/or SGPT.

Different types of determinations usually performed:

16-28	Routine
2-5	Enzymes
0	Endocrinology
1-2	Toxicology

Excellent

Can perform all routine tests, at least four Enzyme tests and at least two screening tests for Toxicology and Blood gasses.

Different types of determinations usually performed:

29-38	Routine
4-8	Enzymes
0-2	Endocrinology
3-6	Toxicology

HEMATOLOGY

Poor

A minimum number of tests are performed and the quality of laboratory procedures rated as poor or unacceptable. Technicians are unable to recognize gross abnormalities, equipment is inaccurately calibrated and unacceptable techniques and methods are used. For example, sedimentation racks are not level and sometimes visibly tilted to one side; hemoglobin results are often reported in percent of normal rather than in grams; no description of red blood cells and platelets from blood smears is reported; blood smears for differential white counts are performed from oxalated blood which has stood several hours.

Average

Special procedures, such as bone marrow differentials, red blood cell fragility tests, L. E. Preparations, body fluid cell counts and sperm cell counts may or may not be performed. When these procedures are performed, acceptable methods and calibrated equipment are used under qualified supervision. In addition, the standard battery of hematology tests also are performed under these same conditions.

Excellent

Compared to average, a broader range of tests are performed, equipment and methods are more refined and reports are more closely examined and compared before release. Usually several highly sophisticated tests, such as the Phase Microscope for counting platelets, Hemoglobin Electrophoresis and Fetal Hemoglobins, are performed.

APPENDIX C

TECHNOLOGIST

University of North Carolina at Chapel Hill
School of Medicine
Department of Hospital Administration

A QUESTIONNAIRE FOR LABORATORY TECHNOLOGISTS

Introduction

For your convenience, this next series of questions is arranged to be answered by merely circling a number. (A few questions may require a small amount of writing.)

On Confidentiality

As in our entire study, these results will be held in absolute confidence. Only a number will appear on this questionnaire for identification; the corresponding name will be maintained in a separate locked file until the study is terminated and then the list of names will be destroyed. Results from the study will appear only in statistical tables and summary statements. Neither localities, hospitals nor individuals will be identified in any of our reports or publications.

Answering the Questions

As far as we are concerned, there are no "right" or "wrong" answers to our questions. We are interested only in your opinions.

Prepared under contract with the U. S. Department of Labor
Bureau of the Budget No. 44-6411
Expiration Date: September 30, 1965

APPENDIX C

1. Some occupations are well known and clearly understood by those in the community such as school teacher, fireman, etc., while other occupations are neither known nor understood such as public service administrator or management consultant. As for those you meet OUTSIDE THE HOSPITAL:

   Describe the kind of reaction people have to your occupation. (Circle one number.)

   1. Most people know about it and most people understand it.
   2. Most know about it and many understand it.
   3. Most know about it but few understand it.
   4. Most know about it but no one understands it.
   5. Many know about it and understand it.
   6. Many know about it but few understand it.
   7. Many know about it but no one understands it.
   8. Few know about it and understand it.
   9. Few know about and no one understands it.
   10. No one knows about it or understands it.

2. Some occupations such as business or clergy seem to help one meet others in the community. Other occupations may actually hinder one in becoming acquainted with others. What would you say about your occupation in regard to becoming acquainted with others IN THE COMMUNITY. (Circle one number.)

   1. It definitely helps.
   2. It helps more than it hinders.
   3. It neither helps nor hinders.
   4. It hinders more than it helps.
   5. It definitely hinders.
   6. No opinion.

3. Some people prefer to remain in one locality during their adult life, others may prefer to move from place to place and some must live in a particular location because of circumstances they cannot completely control. Which best describes your situation as to your living location? (Circle one number.)

   1. I prefer to remain here and will do everything possible to stay.
   2. I prefer to remain here but, if a better opportunity comes along, I will move.
   3. I will live almost anywhere in the U.S., if a better opportunity comes along.
   4. I do not have much choice as to where I live, as the circumstances of others determine this.
   5. None of these, rather ______________________________

      ____

      ____

APPENDIX C

4. In your opinion, how many of the following laboratory settings might offer satisfactory professional opportunities for a person of your training and skill? (Circle all that apply.)

    1. Small community hospital (100 beds or less.)
    2. Small private laboratory (serving local hospitals and physicians).
    3. Small government laboratory (serving cities, counties).

    4. Medium community hospital (101 to 300 beds).
    5. Medium private laboratory (serving statewide physicians and hospitals).
    6. Medium government laboratory (serving states).

    7. Large community hospital (300 beds and up).
    8. Large private laboratory (serving regional or national clientele).
    9. Large government laboratory (regional or federal).
    10. Teaching hospital (affiliated with medical school).

5. FIRST, read over the ability and experience descriptions.

ABILITY AND EXPERIENCE DESCRIPTIONS

1. A speciality area for me - I make many determinations, could or do conduct original research which has or might be published in professional journals. I am familiar with most late developments. I might be qualified to teach experienced laboratory technologists techniques and methods in this area.

2. I conduct many determinations in this area. I may have made minor improvements, but I may be unaware of some new techniques developed in the last six months. I am qualified to teach the current acceptable method used for determinations in this area.

3. I perform, or could perform, determinations in this area without extensive review, study or assistance. I am neither qualified to teach nor improve methods in this area without further study and training.

4. I perform, or could perform, if necessary, determinations in this area; but each time I would have to review procedures or seek assistance.

5. I have neither (or only on rare occasions) performed determinations in this area nor do I presently feel qualified to perform determinations in this area.

NOW, circle the number in the space provided that best describes your ability and experience for each area of laboratory technology.

Bacteriology	1	2	3	4	5
Chemistry	1	2	3	4	5
Blood Bank	1	2	3	4	5
Hematology	1	2	3	4	5
Serology	1	2	3	4	5
Urinalysis	1	2	3	4	5
Histology	1	2	3	4	5

6. In your opinion, which place is the most desirable to live for a person of your temperament and interest? *Please read all choices before you circle your selection.* (Circle one number.)

    1. Farm.
    2. Open country, non-farm.
    3. Small town.
    4. Small or medium sized city.
    5. Suburbs of a small or medium sized city.
    6. Large metropolitan city.
    7. Suburbs of a large metropolitan city.
    8. Place is not important.

7. In your opinion, which place would offer you the best professional opportunity? *Please read all choices before you circle your selection.* (Circle one number.)

    1. Small Town.
    2. Small or medium sized city.
    3. Suburbs of a small or medium sized city.
    4. Large metropolitan city.
    5. Suburbs of a large metropolitan city.
    6. Place is not important.

8. As you know, each profession develops its own set of "ethics" - guiding principles of personal behavior and quality of work performance. Of course, each professional person is responsible to maintain the ethics of their profession.

    In your opinion, which statement best describes the ethical standards for laboratory technology. (Circle one number.)

    1. A highly developed code of ethical standards which is shared by almost everyone in laboratory technology.

    2. Common ethical standards in some areas but many areas in laboratory technology are unclear or not developed.

    3. No common set of ethical standards for laboratory technology but a variety of standards for different hospitals, clinics, parts of the country, *et cetera*.

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9. Listed below are activities in which laboratory technologists may or may not participate. As you read each activity, please circle the number that describes the extent of your participation in each one.

	1 Regularly	2 Often	3 Occasionally	4 Never
Taking courses in laboratory technology (extension, refresher, continuing education, etc.)	1	2	3	4
Instructing others.	1	2	3	4
Contributing articles to journals, magazines or writing books on laboratory technology.	1	2	3	4
Attending local, regional or national meetings in laboratory technology.	1	2	3	4
Associating with technologists in other hospitals or clinical laboratories.	1	2	3	4

10. As you know, some people are deeply committed to their occupation while others work only because of temporary circumstances. Which of the following categories best describes your commitment to this occupation? (Circle one number).

    1. My work in this occupation is temporary and I plan to quit at the first opportunity.

    2. I will probably leave this occupation eventually, but right now I do not know when.

    3. This occupation is my permanent career and I have no plans to leave this field of work.

    4. None of these, rather ______________________________

    ____

11. As you know, many laboratory procedures have become automated recently and more appear to be on the way. Which of the following statements best describes how you feel this trend will affect your career? (Circle one number).

APPENDIX C

1. Some day soon I may be replaced by a machine.
2. I may need additional training or have to take on new duties to stay employed as a technician.
3. I don't think automation will affect my career one way or the other for quite some time.
4. Automation will free me from boring tasks making laboratory tasks more interesting.
5. None of these, rather ______________________________

____

12. Given your choice, which working situation would you prefer:

Working in several areas of laboratory technology, including:		Specializing in one field of laboratory technology which is ________
(Circle all you prefer)	OR	(Circle one number -
1. Bacteriology		1. Bacteriology
2. Chemistry		2. Chemistry
3. Blood Bank		3. Blood Bank
4. Hematology		4. Hematology
5. Serology		5. Serology
6. Urinalysis		6. Urinalysis
7. Histology		7. Histology

13. How often and under what what conditions do you see others that work in the hospital? As you read over the list of people below, circle the number that best describes your contacts with them. Of course it is possible to see the same person socially as well as professionally. If this is the case with some of your contacts, circle numbers in all areas that apply.

	Within the Hospital Professionally			Within the Hospital Socially			Outside the Hospital Socially		
	Often	Occasinally	Never	Often	Occasionally	Never	Often	Occasionally	Never
Pathologist	1	2	3	1	2	3	1	2	3
Other lab workers	1	2	3	1	2	3	1	2	3
Other doctors	1	2	3	1	2	3	1	2	3
Hospital admin.	1	2	3	1	2	3	1	2	3
Others in admin.	1	2	3	1	2	3	1	2	3
Nurses	1	2	3	1	2	3	1	2	3
Other hospital employees	1	2	3	1	2	3	1	2	3
Patients	1	2	3	1	2	3	1	2	3
Other:									
____________	1	2	3	1	2	3	1	2	3

APPENDIX C

14. Some questions may have stimulated your thinking in areas we have not covered in this questionnaire. Please feel free to jot down any additional thoughts or ideas you may have. (Use the back of this page, if necessary.)

    1. No further comments. ______________

    2. My further comments are:

    ____

    ____

    ____

    ____

    ____

    ____

    ____

    ____

    ____

    ____

    ____

    ____

Thank you for your time and co-operation.

APPENDIX C

TECHNOLOGIST

University of North Carolina at Chapel Hill
The School of Medicine
Department of Hospital Administration

INTERVIEW SCHEDULE FOR LABORATORY TECHNOLOGIST

Interviewer

____________________________________ Date ____________ ,1965
Month Day

Introduction

Hello, my name is ____________________ from the University of North Carolina, Chapel Hill. I am working on the Laboratory Manpower Study and I would like to ask you some questions about your work here and your personal background.

1. Respondent code (Circle).

M F W NW

2. We would like to have a detailed review of past jobs you may have held before you started this position. Let's start with you very first job, excluding baby sitting, even if it was part-time after school or during the summer. (Include present position.)

Job Description - Employer Type	Full-time or Part-time	Months/ Years	Pay Rate (Specify Time)

(Note interruptions between jobs for next question.)

Prepared under contract with the U.S. Department of Labor
Bureau of the Budget No. 44-6411
Expiration Date: September 30, 1965

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For those who have interrupted their work experience in laboratory technology: (ask for each interruption)

3. We would like to know about some of the circumstances and events connected with your return to work. (Code response.)

	1st Interruption	2nd Interruption	3rd Interruption	4th Interruption	5th Interruption
Was your return to work prearranged with your employer? (A leave of absence, for example.)	1	1	1	1	1
Did you, on your own, decide to return to work and then go out and seek a position?	2	2	2	2	2
Did someone suggest an opportunity was available and then you decided to apply for the position?	3	3	3	3	3
Did someone in the laboratory actively seek you out for employment and then you accepted?	4	4	4	4	4
Did someone in the hospital actively seek you out for employment and then you accepted?	5	5	5	5	5
A combination of the above or some other set of circumstances, please describe:	6	6	6	6	6

____

____

____

4. We are going to ask you to recall some of the circumstances that led to your choice of this occupation. Now I am going to ask you to read over this list and would you please circle all those persons, circumstances and events which played a part in your selection of this occupation. (After respondent returns list, circle number (s), probe each area circled). Below list was attached to questionnaire). List numbers on schedule:

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

____

____

____

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1. Parents (or parent or guardian)
2. Other relatives (including spouse)
3. Close friend or friends.
4. Acquaintance.
5. Member of the community.
6. High School teacher.
7. High School Guidance counselor.
8. Other counselor.
9. College teacher.
10. Physician.
11. Other health worker.
12. Illness experience (personal family.)
13. Work experience.
14. Volunteer work experience.
15. Educational experience.
16. Books, articles, newspapers, other written materials.
17. Lecture or discussion.
18. TV, radio or motion pictures.
19. Health "career day."
20. Other, specify:

____

____

5. We are very interested in finding out how people like yourself go about finding a new position. If, for one reason or another, you decided to take a new position similar to the one you have now in a different town, how would you go about it? (If respondent replies something like this, "I would go to the hospital in the town and ask if they needed a technologist," then probe for a situation in which several opportunities may exist in one town or city.)

____

____

6. We are asking you to recall the time after you completed your specialized training for this occupation and first began to work. How well were you prepared to carry out the duties and responsibilities assigned to you on your first job?

____

____

Now about your own personal background, first of all:

7. We would like to know the kinds of places you have lived during your life and how long you have lived in each one. Let's start with the place where you lived most of the time when you were growing up.

	# of Yrs.	# of Yrs.	# of Yrs.	# of Yrs.	# of Yrs.	# of Yrs.	# of Yrs.
	___	___	___	___	___	___	___
1. Farm.	1	1	1	1	1	1	1
2. Open country, non-farm	2	2	2	2	2	2	2
3. Small town.	3	3	3	3	3	3	3
4. Small or medium sized city.	4	4	4	4	4	4	4
5. Suburbs, small-medium sized city.	5	5	5	5	5	5	5
6. Large metropolitan city.	6	6	6	6	6	6	6
7. Suburbs, large metropolitan city.	7	7	7	7	7	7	7

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8. What is (or was) your father's regular occupation - the occupation that he has (or had) most of his life? (Get a brief description of major tasks.)

____

9. What was the highest number of years of school you completed?

Grammar School	High School	College
1 2 3 4 5 6 7 8	9 10 11 12	1 2 3 4 5 6

10. Did you graduate from high school? Yes ____________ No ____________

11. Please describe any schooling you received beyound the high school. For instance, college, junior college, night school, correspondence school, etc. (Include military training.)

Name of Institution	Location of Institution	Course or Major	Degree Received	Year Degree Received

12. What is your present title? ______________________________

13. What kind of housing do you live in now?

	Total No. of Rooms	Buying or Renting	Total Monthly Costs
1. Single detached dwelling unit.			
2. Single attached dwelling unit.			
3. Apartment			
4. Trailer			
5. Room in private home.			
6. Other, specify ____________			

14. Would you please describe all those who are currently living in your household by their relationship to you, age, current occupation.

Relationship	Age	Present Occupation
Respondent		

15. Who is primarily responsible for the main daily household task of preparing food, washing clothes and household cleaning and upkeep?

____

16. Do you experience any difficulties or problems in carrying out your responsibilities at home and maintaining a working schedule?

________ No

________ Yes *

*17. If yes, please describe: ____

____

18. If no, have you ever?

________ No

________ Yes *

*19. If yes, please describe and tell how these problems or difficulties were overcome: ____

____

20. Marital Status

1. Single, never married. ______
2. Married. ______
3. Separated, divorced or widowed. ______

21. Are you a citizen of the United States?

______ Yes

______ No *

*22. If not, in what country are you a citizen? ___________________________

23. Here are a number of cards we would like you to sort into three separate stacks. Each card describes characteristics said to be important in order to be a laboratory technologist.

1. For the first stack, select the cards that describe characteristics you feel a person must have:

   Before entering training.

2. For the second stack, select the cards that describe characteristics that you feel a person must gain:

   During training.

3. For the third stack, select the cards that describe characteristics you feel a person can only acquire:

After working experience.

24. The interviewer will select cards from Stacks 2 and 3 and ask, "Would you please separate these cards into two piles."

    1. Characteristics which were least difficult for you to acquire.
    2. Characteristics which were most difficult for you to acquire.

25. Additional comments:

APPENDIX C

SUPERVISOR

University of North Carolina at Chapel Hill
The School of Medicine
Department of Hospital Administration

INTERVIEW SCHEDULE ON THE CLINICAL LABORATORY IN THE HOSPITAL

Interviewer

_________________________ Date _________________, 1965
Month Day

Introduction

Hello, my name is ____________________ from the University of North Carolina, Chapel Hill. I am working on the Laboratory Manpower Study and I would like to ask you some questions about this laboratory and the people who work here.

First, we understand you are the supervisor of the clinical laboratory in this hospital. Is that correct? *

1. Are you a full-time employee?

   ______________ Full-time
   ______________ Part-time

2. Respondent code (circle).

   M F W NW

We would like to find out a few things about your own background.

3. How many years have you worked as a laboratory technologist?

   ___________ Number of Years

4. How many total years have you worked as a laboratory supervisor in this or any other laboratory?

   _______________ Number of Years

* If this is not the supervisor, excuse yourself after finding the correct person's name. If this respondent is temporary, go ahead with the interview.

Prepared under contract with the U. S. Department of Labor
Bureau of the Budget No. 44-6411
Expiration Date: September 30, 1965

5. Now we would like to know about your formal education. (Check highest amount.)

______ High school, non-graduate.
______ High school graduate.
______ College, no degree.*
______ Bachelor's degree.*
______ Master's degree.*

(Ask about military training and describe briefly.)

______

*6. ______ Major course of study. (Write)

7. Do you have a title? (Check)

______ MT (ASCP)
______ MT (AMT)
______ MT (IMT)
______ CLA (ASCP)
______ None
______ Other, specify ______

8. Finally, what is the year of your birth?

______ (Write year.)

Now we would like to discuss the medical supervision in this laboratory.

9. Who is responsible for the medical supervision of this laboratory? (Name is not necessary.)

9

If respondent does not know, check ..... ☐
and code new informant .... ______

______ Pathologist (Skip ahead to question 11.)
______ Chief of the medical staff.
______ Chairman of a medical staff committee.
______ Other physician.
______ Other (describe title) ______

10. Probe for exact arrangements determining amount of supervision, specially of physician; if rotating responsibility, frequency of rotation. (Write comments.)

______

______

For those with pathologist(s):

11. ______ Number full-time.*

*12. Full-time coverage (in full-time equivalents [1/2 day = .5])

_________ Monday
_________ Tuesday
_________ Wednesday
_________ Thursday
_________ Friday
_________ Saturday
_________ Sunday

13. _________ Number part-time.*

*14. Part-time coverage.

_________ About once a year.
_________ About once every six months.
_________ About once a month.
_________ Once a week or more.
_________ None of the above (write description)_________________

____

15. About the physicians in this hospital - how many are on the active medical staff?

15
If respondent does not know, check ..... ☐
and code new informant .... _____

_________ Write number.

16. Of the total number of physicians, about what percent use this laboratory?

16
If respondent does not know, check ..... ☐
and code new informant .... _____

_________ Write percent.*

*17. (Ask only if not 100 percent.) In your opinion, what is the reason some physicians do not use the laboratory?

_________ Don't know.
_________ Not all on staff practice medicine.
_________ Some other reason, specify_________________

____

18. Do other physicians, not on the medical staff of this hospital, use this laboratory?

18
If respondent does not know, check ..... ☐
and code new informant .... _____

_________ No
_________ Yes*

19. If yes, about how many?

______ Write number.

20. How many physicians on the medical staff of this hospital have the following specialty practices?

20

If respondent does not know, check .....☐
and code new informant .... ______

(Read list and write in number [include 0's])

______ Internal medicine.
______ Surgery
______ Oral surgery.
______ Obstetrics and gynecology.
______ Pediatrics, including newborn.
______ Other, specify______

______

______ Anesthesiology
______ Radiology
______ Pathology
______ General practice.

21. Turning now to another area, during the last year have you received any outside consultation services for this laboratory? (Excluding salesmen.)

______ No
______ Yes*

*22. If yes, what were the areas of consultation and how many total days last year did you receive consultation in each area?

Write Areas	Write Number of Days
______	______
______	______
______	______

23. Now we would like to find out a few things about the staff in this laboratory. First of all, during last week, how many full-time laboratory technologists worked in this laboratory and what degrees do they have - how many part-time?

Write No. Full-time	Write No. Part-time	
______	______	MT (ASCP) w/ degree.
______	______	MT (ASCP) no degree.
______	______	MT (AMT) w/ degree.
______	______	MT (AMT) no degree.
______	______	MT (IMT) w/ degree.
______	______	MT (IMT) no degree.
______	______	Degree, but not ASCP or AMT.

Write No. Full-time	Write No. Part-time	
		No degree, not ASCP or AMT.
		CLA (ASCP) w/ degree.
		CLA (ASCP) no degree.
		CLA (AMT) w/ degree.
		CLA (AMT) no degree.
		Laboratory assistant.
		Trainee

24. Considering last year, how would you rate the supply of laboratory technologists for the demands you have had for laboratory services? (Read list and check response.)

__________ Adequate at all times for all requests for services.
__________ Adequate most of the time for requests for services.
__________ Frequently inadequate for requests for services.
__________ Always inadequate for requests for services.

__________ Don't know (do not read this, probe before checking).

25. Are you currently seeking additional personnel for this laboratory?

__________ No
__________ Yes*

*26. If yes, any special areas? ____________________________________

*27. If yes, how are you going about this? ____________________________

____

____

28. In the past five years, have you ever had a training program for laboratory technologists?

__________ No (SKIP AHEAD TO QUESTION 40)
__________ Yes*

*29. If yes, is the program currently running?

__________ Yes
__________ No*

*30. If no, why was it discontinued? ____________________________

____

31. If yes (currently running), what is the percent enrollment and

_________ Write number.

32. What is the present capacity?

_________ Write number.

33. Is it accredited?

_________ No
_________ Yes*

*34. If yes, by whom (write in institution or group). _________________

____

35. Is the training course affiliated with a medical school, college or other similar group?

_________ No
_________ Yes*

*36. If yes, with whom?

____ Write in name.

37. How many weeks does the training course run?

_________ Write in weeks.

38. How many completed the course last year?

_________ Write in number.

39. (Now probe for training, formal vs. informal classes or on-the-job, number of hours, etc., until you can make a judgment.)

Write a summary of your discussion:

____

____

40. How many technologists from this laboratory attended technical meetings last year, excluding departmental meetings?

_________ Write in number.

Active	Infrequent	Never	NA	
____	____	____	____	Respondent
____	____	____	____	Laboratory staff.
____	____	____	____	Pathologist
____	____	____	____	Other physicians.
____	____	____	____	Administrator
____	____	____	____	Other (specify) ______
____	____	____	____	____________________

46. Any further comments on training laboratory personnel?

____

47. For those involved in the supervision of laboratory personnel.

If respondent does not know, check ..... ☐ 47
and code new informant .... ______

Active	Infrequent	Never	NA	
____	____	____	____	Respondent
____	____	____	____	Laboratory staff.
____	____	____	____	Pathologist
____	____	____	____	Other physicians.
____	____	____	____	Administrator
____	____	____	____	Other (specify) ______
____	____	____	____	____________________

48. Any further comments on the supervision of laboratory personnel?

____

49. For those involved in laboratory budget allocation.

If respondent does not know, check ..... ☐ 49
and code new informant .... ______

Active	Infrequent	Never	NA	
____	____	____	____	Respondent
____	____	____	____	Laboratory staff.
____	____	____	____	Pathologist
____	____	____	____	Other physicians.
____	____	____	____	Administrator
____	____	____	____	Other (specify) ______
____	____	____	____	____________________

50. Any further comments on laboratory budget allocation?

____

____

51. For those involved in budget planning.

51
If respondent does not know, check ..... ☐
and code new informant .... ____

Active	Infrequent	Never	NA	
			____	Respondent
____	____	____	____	Laboratory staff.
____	____	____	____	Pathologist
____	____	____	____	Other physicians.
____	____	____	____	Administrator
____	____	____	____	Other (specify) ______
____	____	____	____	____________

52. Any further comments on budget planning?

____

____

53. For those involved in the rearrangement of existing space assignments.

53
If respondent does not know, check ..... ☐
and code new informant .... ____

Active	Infrequent	Never	NA	
			____	Respondent
____	____	____	____	Laboratory staff.
____	____	____	____	Pathologist
____	____	____	____	Other physicians
____	____	____	____	Administrator
____	____	____	____	Other (specify) ______
____	____	____	____	____________

54. Any further comments on space assignments?

____

____

55. For those involved in allocating new space assignments.

55
If respondent does not know, check ..... ☐
and code new informant .... ____

Active	Infrequent	Never	NA	
____	____	____	____	Respondent
____	____	____	____	Laboratory staff.
____	____	____	____	Pathologist
____	____	____	____	Other physicians.
____	____	____	____	Administrator
____	____	____	____	Other (specify) ______
____	____	____	____	______________________

56. Any further comments on new space assignments?

____

____

57. For those involved in laboratory space planning.

If respondent does not know, check ..... 57 ☐
and code new informant .... ____

Active	Infrequent	Never	NA	
____	____	____	____	Respondent
____	____	____	____	Laboratory staff.
____	____	____	____	Pathologist
____	____	____	____	Other physicians.
____	____	____	____	Administrator
____	____	____	____	Other (specify) ______
____	____	____	____	______________________

58. Any further comments on space planning?

____

____

59. What is the starting monthly salary you offer for the following categories of technologists?

If respondent does not know, check ..... 59 ☐
and code new informant .... ____

Write salary (NP = no policy).

$ __________ MT (ASCP) w/ degree.
__________ MT (ASCP) no degree.
__________ MT (AMT) w/ degree.
__________ MT (AMT) no degree.
__________ Degree, but not ASCP or AMT.
__________ No degree, not ASCP or AMT.
__________ CLA (ASCP) w/ degree.
__________ CLA (ASCP) no degree.

__________ CLA (AMT) w/ degree.
__________ CLA (AMT) no degree.
__________ Laboratory assistant.
__________ Trainee

60. Do you provide any additional salary compensation for "off-duty" work?

__________ No
__________ Yes

61. Any further comments on "off-duty" work?

____
____
____
____
____
____
____

62. We would like you to consider the entire staff of this laboratory for the moment, then rate their overall technical competence.

__________ Superior
__________ Above average.
__________ Average
__________ Below average.

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